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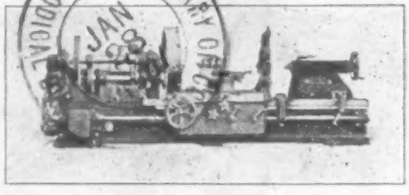

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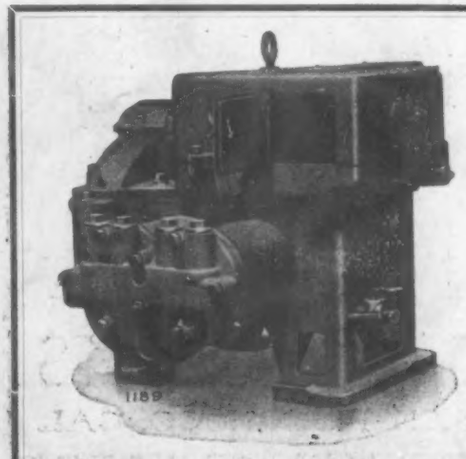

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				Full Load	¾ Load	½ Load	¼ Load	
22	4.4	16	2.74	93.	93.1	92.7	87.1	500
26	3.33	22	2.72	94.	94.1	92.9	88.2	750
30	3.00	27	2.70	94.6	94.50	93.19	89.86	1000
37	2.42	34	2.46	95.4	95.41	94.28	90.50	1500
44	2.20	46	2.43	95.70	95.79	94.57	91.00	2000
48	1.92	55	2.37	96.00	96.12	95.41	92.53	2500
49	1.63	60	2.30	96.40	96.54	95.93	93.50	3000
55	1.37	82	2.27	96.67	96.82	96.31	94.40	4000
61	1.22	100	2.15	96.83	97.12	96.70	95.00	5000
87	1.16	145	1.98	97.00	97.32	97.02	95.40	7500
105	1.05	177	1.83	97.25	97.48	97.21	95.52	10000
122	.98	202	1.76	97.40	97.70	97.39	95.95	12500
134	.90	252	1.64	97.50	97.74	97.42	96.11	15000
163	.80	320	1.55	97.64	97.89	97.79	96.46	20000
187	.75	380	1.48	97.78	98.03	97.88	96.76	25000
204	.68	432	1.42	97.92	98.12	97.96	97.01	30000
244	.60	556	1.40	98.04	98.28	98.12	97.29	40000
271	.54	640	1.30	98.21	98.44	98.30	97.57	50000

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The Engineers' Architects' and Builders' News

VOLUME XVIII. SAN FRANCISCO, CAL., JANUARY 12, 1907 No. 2

American and Foreign Vertical Engines.

It is generally conceded that the high speed engine has been developed in England to a higher degree of perfection than in any other European country or in America. The vertical compound and triple expansion engines of high power, both for low and high speeds, are, perhaps, more commonly employed in modern English power plants than any other type.

In America, also, this engine is largely used, probably more so than engines of the horizontal type. Fig. 1 shows a characteristic high-power American engine used for driving large generators. This engine was built for the power station of the Cincinnati Gas and Electric Co. by MacIntosh Seymour & Co., and can develop about 5,500 horsepower. The cylinder dimensions are 40 and 82 by 54 inches. Two 1250-kilowatt continuous current generators are driven at a speed of 100 revolutions per minute.

Fig. 2 represents a distinct type of a French triple expansion engine, having a capacity of 1200 horsepower. Fig. 3 shows a vertical compound engine of German design direct connected to a dynamo supplying continuous current at a pressure of 500 volts. The valve gear is constructed according to the Lentz system. Another German compound engine is that shown in Fig. 4, having been built in Stuttgart by G. Kuhn.

An interesting power plant where vertical engines are employed is that of La Compagnie Parissienne de l'Air

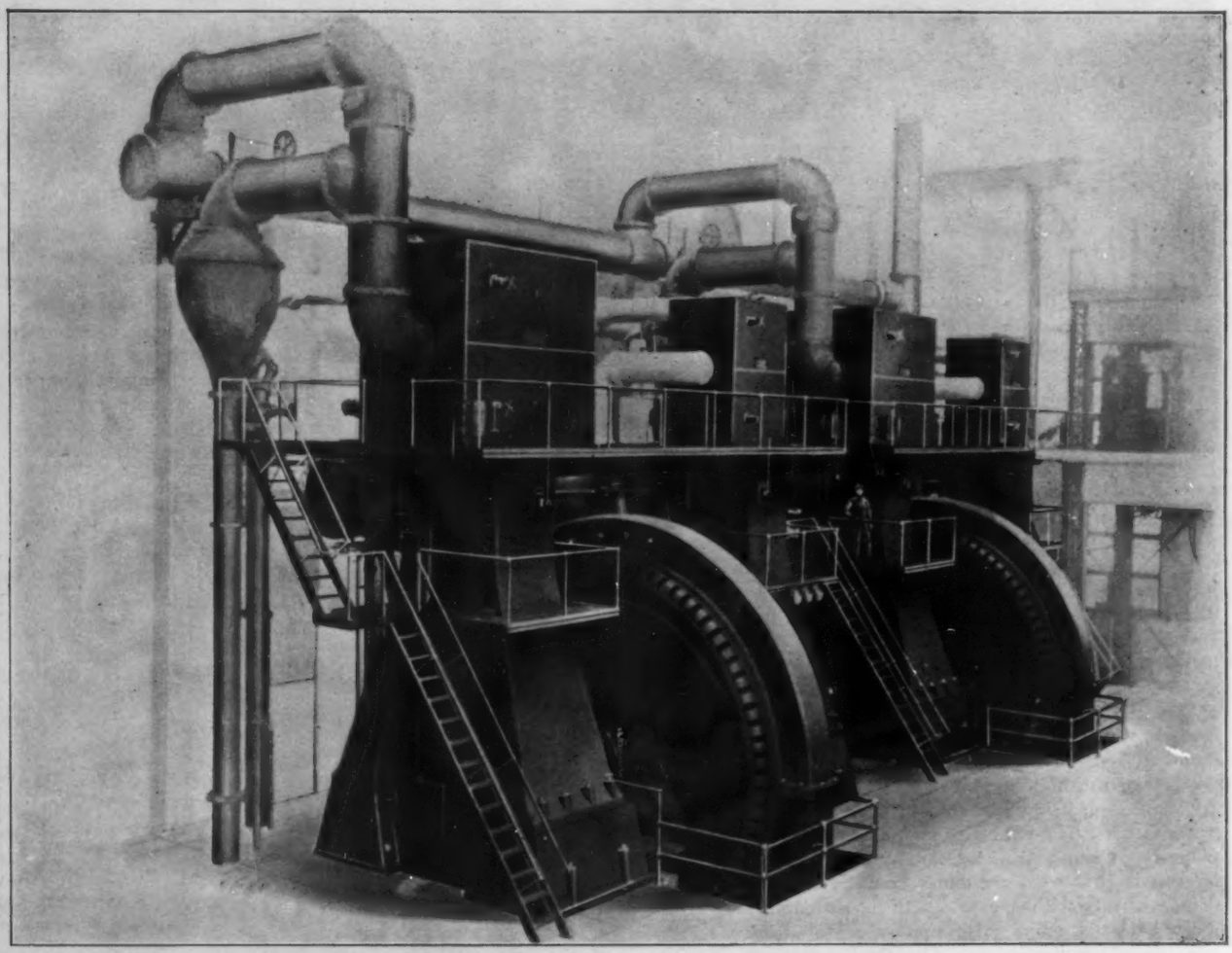


FIG. 1. AMERICAN VERTICAL CROSS COMPOUND McINTOSH & SEYMOUR ENGINES OF 3,000 TO 4,500 HORSEPOWER AT THE POWER PLANT OF THE UNITED RAILWAYS & ELECTRIC CO. OF BALTIMORE, MD.

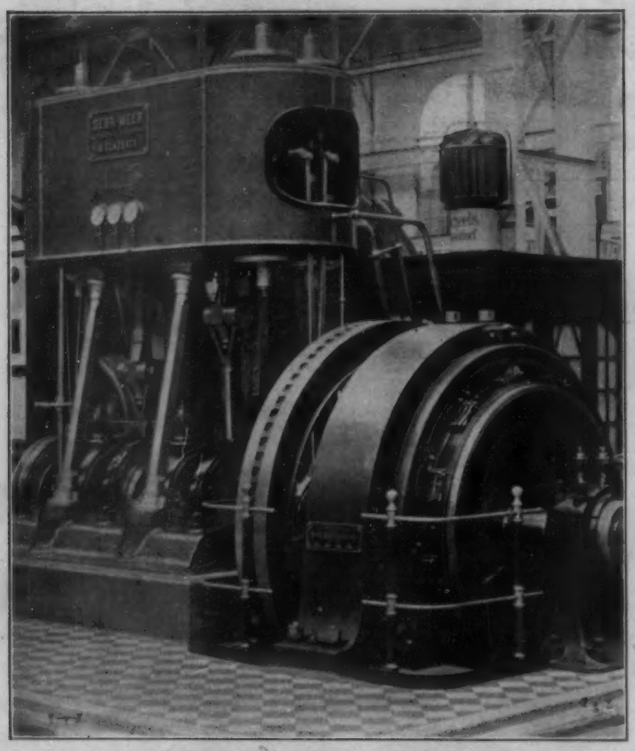


FIG. 3. 250-KILOWATT, 500-VOLT SCHORCH DIRECT CURRENT DYNAMO DIRECTLY COUPLED TO VERTICAL COMPOUND STEAM ENGINE, BUILT BY GEBR. MEER, OF M. GLADBACH.

Comprime, situated near the quay of Jemmapes in Paris. This plant was designed for a total capacity of 27,600 horsepower, and consists of 23 units. The plant is built on a site trapezoidal in shape, 90 meters (295 feet) in width, with a frontage of 60 meters (197 feet) on the wharf. On account of the large output required and the small area available it was not possible to adopt the usual custom of placing the engines on the same floor with the boilers. The engines and electrical generators are installed on the first floor, the boilers on the second, and the storage for the fuel on the third floor. A gallery is provided for the switchboards and feeders, communicating at the right and left with the engine room by staircases. The auxiliary apparatus, which includes pumps, coal elevators and hoists, is in the center of the plant and is separated from other machinery by a passage 16 feet in width.

The coal is delivered to the station in boats in quantities of several tons per day, and is mechanically unloaded; brought to the foot of the elevators and automatically dumped into the hopper of an elevator which carries it to the top of the building. The usual endless chain conveyors are employed, being operated by electric motors. The feed water is taken from the city mains, which derive their supply from the Orcq and the Seine rivers. After the water is filtered it passes to an underground reservoir having four compartments with a capacity of 44,000 cubic feet. Electric motor driven pumps raise the water to storage reservoirs situated under the boilers. The condensation water is taken from the canal above the power plant through a pipe 43 inches in diameter, and passes around the engine installation into a canal around the outside walls of the station. Each set of four boilers feeds the vertical steam engine installed directly below it, the quantity of steam for each unit being about 17,200 pounds per hour.

The great economy in floor space by using the vertical steam engine over the horizontal type is well illustrated in this electric station, and the equipment, therefore, deserves a somewhat more detailed description. The boilers are of the tubular type, each supplying 5,500 pounds of steam per hour under a pressure of 114 pounds per square inch. A steam superheater as well as a feed water heater are provided for each boiler which has a fire grate surface of 56.5 square feet and a total heating surface of 2,330 square feet. The heating surface of the tubes is 1,425 square feet. When necessary, three boilers operating at their maximum capacity can supply a single unit, although under ordinary circumstances four boilers are used.

A peculiar arrangement of this boiler plant is that a separate chimney is provided for each group of boilers, the height being 645 feet and the diameter 6.5 feet, so that there is in reality a separate chimney for each 1,300 horsepower vertical steam engine and its group of four boilers. The engines have a steam consumption of 17.6 pounds per electrical horsepower hour, or 24.0 pounds per kilowatt hour. The tests of these engines showed a consumption of 14.3 pounds of steam per effective horsepower hour at the shaft.

The piston strokes measure 3.95 feet. The engine shafts are constructed of mild steel, are 29.5 feet long and weigh 10 tons. There are six bearings to each unit, two outside and four intermediary. One end of the shaft supports a 31-ton fly-wheel, 18.7 feet in diameter, and the other end of the shaft is connected to the dynamo rotor.

The dynamos are of the inner pole type, the current being collected on the periphery of the revolving armature.

There are twelve sets of brushes used in collecting the current. These are mounted on a spider having a diameter of 14.75 feet. The field consists of twelve poles of forged iron joined to a mild steel yoke. The load current is 1,500 amperes, the total power delivered by the generator is 750 kilowatts, at a pressure of 500 volts. Power is delivered to a number of sub-stations, one of which is located at Saint-Roch and another on Mauconseil street. The latter has four stories above ground and three underground, in which are placed the storage battery equipment. Each of the latter floors has four batteries of 280 cells each with five boosters and a switch board. These batteries have a capacity of 2,200 ampere hours, the normal discharge rate being 300 amperes. The boosters are four pole machines separately excited, two machines being mounted on the same shaft.

FIG. 2. FRENCH 1,200-HORSEPOWER TRIPLE EXPANSION ENGINE CONDUCTED BY THE SOCIETE ANONYME DES ESTABLISSEMENTS DELARMAY BELLEVILLE OF SAINT DENIS, FRANCE.

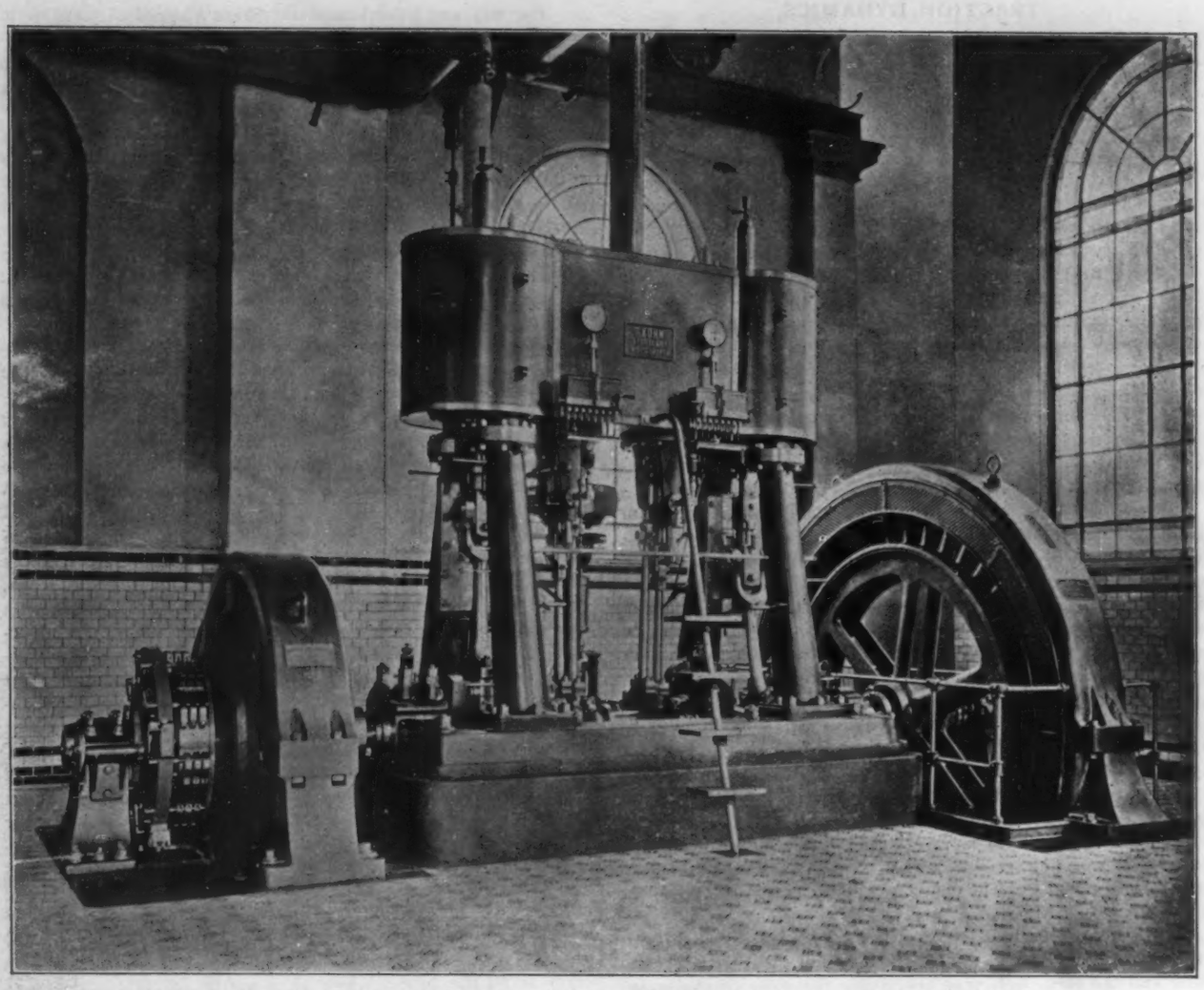


FIG. 4. DIRECT AND ALTERNATING STEAM GENERATOR AT LAHMEYER POWER PLANT.

DOUBLE TROLLEY SYSTEM NOT A SURE CURE FOR ELECTROLYSIS.

At the convention of the Central States Waterworks Association, held in Cincinnati, Ohio, a discussion upon electrolysis of water pipes was started by Joseph J. Pater, who stated that it was his belief that the only method of doing away with this trouble was to force all electric railroads to adopt the double trolley system. This opinion was dissented from by George Hornung, formerly superintendent of the Newport (Ky.) waterworks, and at the present time a consulting engineer of Cincinnati, Ohio. Mr. Hornung first stated that it was not entirely correct to attribute all electrolytic troubles to the street railway, as any stray current may cause electrolysis to take place, and such currents are almost always present in cities where there are large electric generating stations. It is practically impossible to insulate all the systems perfectly so as to prevent any leakage of current.

It is this very feature which defeats the purpose of the double trolley system, and he described, somewhat in detail, his experiences with that system in Cincinnati. The double trolley system, on account of its complicated structure, is much more difficult to insulate than the single trolley system, and this fact is realized in Cincinnati, where a fallen wire is treated with respect; in fact, Mr. Hornung stated that he has known horses to be killed by such wires. He mentioned an experiment conducted on Main street, in Cincinnati, at a time when there were two lines running down that street—one a single trolley, and the other a double trolley system. It was found that by transferring the trolley wheel of a car on the single trolley system to one of the double-trolley wires that the lamps in the car were lighted, and by turning the controller handle the motors, while not able to start the car, exerted a considerable torque. This experiment was repeated again several years later, with the same result.

NEW GAS MANTLE.

The "Scientific American" says that a German patent has been granted for a new process in spinning artificial threads made from cupric oxide and cellulose, and knitting the fabric for the mantles in the ordinary way. These mantles are subsequently impregnated with the thorium salts, and after drying are placed in a bath of ammonia, or hydrogen peroxide. This last bath is the essential point of the invention, as it converts the previously soluble salts into insoluble compounds, i. e., hydroxides. Since hydrogen peroxide only transforms the salts of thorium into an insoluble state, it is necessary to make use of a cerium bath, after the hydrogen peroxide treatment, in order to give the mantles the necessary one per cent of ceria.

TRACTION DYNAMICS.

By Elbert G. Allen, Chief Electrical Engineer of the Seattle Electric Co.

The energy required for moving any car is composed of three components: (1) that required to overcome the inertia of the car; (2) that required to raise the car against the force of gravity; and (3) that required to supply the losses of train resistance. In any closed cycle of train movement where the car returns to rest at the starting point the energy which was expended in overcoming the inertia of the car and in raising it against the force of gravity is returned to the car again. This returned energy may be again expended in train resistance losses or it may be that it is necessary to waste it in bringing the car to rest by braking. The ultimate causes for loss of energy are then train resistance and braking.

As is the case with any moving machinery, friction or train resistance cannot be avoided. It can be reduced somewhat by careful alignment of track, reduction of grades, easement of curves, etc., but in general the train resistance for a given class of cars at a certain speed is a fixed and unchanging quantity. In general, train resistance may be attributed to three causes: journal friction, rolling friction of wheel on rail, and wind resistance. Since the first component is independent of the speed, the second inversely proportional to it and the third varies with some power of the speed, the resulting total train resistance is a complex function of the speed.

For comparison, train resistance is usually expressed in pounds per ton weight of the car or train. Such figures are not consistent between various sizes of cars and under varying conditions, but as a means of comparison between cars of a given class, train resistance is very nearly proportional to the weight of the cars.

The wind resistance of a train consists of that of the pressure on the front vestibule, the suction on the rear vestibule and the skin friction of the air on the sides of the train. Consequently, the amount of wind resistance varies greatly with the shape of vestibules, amount of surfaces exposed per ton weight, etc. The Railway Test Commission of the St. Louis Exposition made a very interesting series of tests to determine the effect of shapes of vestibules on the wind resistance, and found that a flat vestibule creates the greatest air pressure, the standard form of vestibule being better, but a parabolic form being still better.

Wind resistance increases very rapidly with high speeds, becoming a very important factor in high speed work. In such cases the shape of vestibule should be very carefully considered in order that the amount of power absorbed may be minimized.

It should be borne in mind that for a given equipment, schedule and road bed, the power lost in train resistance cannot be decreased and, therefore, these conditions should be very carefully scrutinized in order that the losses may be kept as low as possible. Low maximum speeds are desirable from the point of view of power consumption.

Very reliable information has been obtained experimentally during the past few years regarding train resistance, and the General Electric Company's formulae and the results of the St. Louis Test Commission may be considered authoritative.

(Editor's Note—This paper is the first of a series of lectures which will be delivered during the ensuing year before the College of Engineering at the University of Washington and Seattle, by distinguished practicing engineers. The complete series of lectures will be published in the columns of the "Journal" as they are delivered.)

For city and suburban work where a speed of 30 m. p. h. is not exceeded it is ordinarily safe to assume that train resistance is 20 pounds per ton. For high speed interurban calculations the resistance varies with the speed so greatly that the more complex formulae must be used.

The loss of energy through braking is very variable and largely affected by conditions of schedule, grade, etc. For a certain class of service the amount of braking is almost solely responsible for the widely different number of watt hours necessary for each ton mile of car travel, due particularly to the "personal equation" of the motorman. It is, therefore, very important that schedules, gear ratios, grades, etc., be selected so far as feasible with a view to reducing the amount of braking necessary.

Steep grades increase the loss of energy through braking; for on all grades steeper than about one per cent, the component of the car's weight tending to propel the car exceeds the train friction and in order to prevent acceleration the brakes must be applied. Thus the energy which has been stored in the car as potential energy on ascending the grade cannot be entirely utilized to overcome friction on descending.

As an example, on a certain line with a difference of elevation of 163 feet between termini, a car on test tools consumed 20.4 kilowatt hour outbound, making 24 stops, and 16.5 kilowatt hour inbound, making 16 stops. Correcting these values for the amount of energy necessary for overcoming grade, we find that the actual losses were 18.0 kilowatt hour outbound, and 18.9 kilowatt hour inbound, so that in spite of the less number of stops the inbound trip consumed nearly 5 per cent more energy, principally on account of the braking on down grades.

On another line about three miles long with a maximum grade of 11½ per cent and a difference of elevation of about 380 feet between termini, a car required 5 kilowatt hour per car mile outbound and 1.86 kilowatt hour inbound. Correcting these values for elevation we find the loss to be 3.25 kilowatt hour per car mile outbound, and 3.61 kilowatt hour inbound, an increase of over 11 per cent. Here the average grade is about 2.4 per cent, and theoretically the car should possess sufficient potential energy at the outer terminus to carry it to the other, while as a matter of fact, some 4.38 kilowatt hours were necessary.

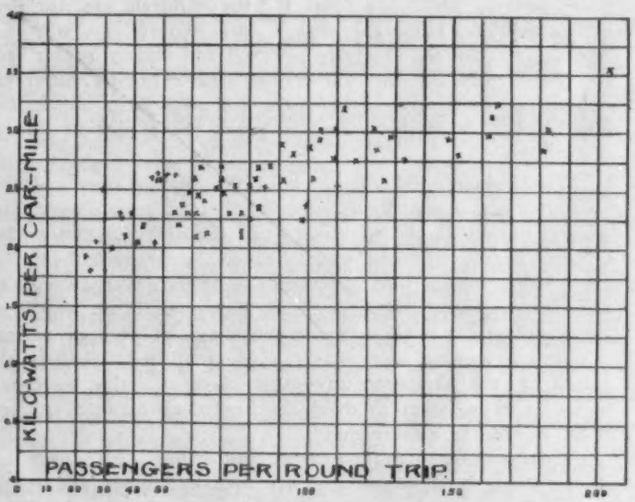
The schedule has a very important bearing on power consumption. With an easy schedule much drifting can be introduced into the car movement and braking be begun with a lower speed, so that less energy be actually lost from this cause. Mr. Gotshall, in his book on "Railway Economics," shows that in one case a decrease in schedule speed of 11.7 per cent allowed a decrease in energy loss of 48.8 per cent. Here, however, results may be very much altered by the personal characteristics of the motorman, and comparisons should be made with care.

The effect of gear ratio on power consumption is similar to that of the schedule in that it affects the amount of coasting possible. A high gear ratio means that a car runs at a low rate of speed, but has a high torque available for acceleration. Such a car can get up speed quickly, but its maximum speed is low. Where a car is obliged to accelerate frequently and does not ordinarily run any great distance at its maximum speed, as is the case in urban work, such conditions are desirable. In general it is best to use as low speed gears as possible and allow the required schedule to be made with ease. This is desirable for the equipment and power station, as the starting current is light. It gives minimum losses, as rheostat losses are small and the losses incident to high maximum speeds are cut down. One should not reduce the speed to such an extent that it is difficult to make the required schedule, but usually it is the other way. A car on a certain division showed an average consumption of 2.55 kilowatt hour per car mile with gear ratio 3.42 and 2.42 kilowatt hour per car mile with gear ratio 3.94, a decrease of 5 per cent. A single truck car on another division showed

a decrease from 2.78 to 2.39 kilowatt hour per car mile on changing the gear ratio from 3.55 to 4.85, a decrease of 13½ per cent.

The line voltage supplied has an effect on power consumption dependent on other conditions. If no attempt is made to hold the schedule and the proportion of coasting is maintained, a decrease in line voltage decreases the watt hours consumed per car mile on account of the decrease in motor and rheostat losses due to decrease in current values and decrease in train resistance losses due to decrease in speed. If, however, an attempt is made to maintain the schedule speed with low voltage, the power consumption may be increased even above normal as the increase due to cutting out coasting may overbalance the saving due to the decrease of losses with speed. Since the current values are increased in such a case due to rapid acceleration, the motor and rheostat losses are also increased.

Rates of acceleration, as well as braking, affect the power consumption, for with more rapid rates more ground is covered during periods of acceleration and more coasting may thereby be introduced. Increase in acceleration is obtained, however, at the expense of increased currents which tend to overload the motor and increase the motor and rheostat



PLOT SHOWING VARIATION OF POWER CONSUMPTION WITH NUMBER OF PASSENGERS CARRIED.

losses. Too high a rate of acceleration increases the motor losses on account of the high rate of input, too low a rate of acceleration increases the motor losses by increasing the length of time the motor must remain in circuit in order that the schedule may be maintained. A mean value giving minimum losses should be selected and the equipment adjusted for this rate.

The number of passengers carried on a car affects the power consumption somewhat, partly on account of additional weight carried, but chiefly because of the increase in the number and length of stops. Each stop adds directly to the power of consumption the amount of energy lost in braking to a stand-still, and indirectly by making the schedule harder to make and the coasting possible correspondingly less. The accompanying plot shows how the power consumption increases with the number of passengers carried. It also indicates what diversity of results may be expected from trip to trip on account of a change in motorman and incidental circumstances.

Theoretically, with no braking losses, it may be shown that the power consumption in watt hours per ton mile should be numerically twice the train resistance expressed in pounds per ton. Expressions for the theoretical loss in braking may also be worked out. While these values are good and valuable as a matter of comparison, and as a guide, the results obtained are lower than those obtained in actual operation on account of various factors which cannot be given consideration in a theoretical formula. As a basis of estimate it is best to use figures which have been obtained in tests under conditions similar to those under which the cars for which estimates are desired, will operate. Values of watt hours per ton mile will, of course, vary greatly. The St. Louis Test Commission gave results which may be considered typical. These results average 83 watt hours for an interurban car, 122 for a double-truck city car, and 162 for a single-truck city car. These values should not be used, however, without careful reference to the original report to check all conditions which existed in these tests.

Another factor which is as important, if not more so, than the watt hour or average loss, is the maximum power demand of a car or system, for this is what determines the number of feeders required and the size of generating or converting apparatus. With an interurban road which operates on a definite schedule with few stops and accelerations, the maximum demand may be foretold with considerable nicety by laying out current-time curves for each train and summing them in accordance with the result desired. With city and suburban systems, however, where cars are many and stops are made whenever necessary and where no feature of the operation can be foretold except schedule and speed, such methods are impossible.

For such cases one may well have recourse to the use of load factors. The load factor is the ratio of the average to the maximum demand, and is a fairly definite figure for a given condition. The average demand of a system is, of course, equal to the sum of the individual average demands of each car as it represents the total energy required. The maximum is, however, less than the sum of the various maxima as these individual maxima do not occur simultaneously. Consequently the load factor improves as the number of cars increases. For a single car during a run with ordinary length of stops the load factor may be as low as 10 or 12 per cent. From this the value increases till a large system of several hundred cars may have a load factor of 60 per cent. or better. The all-day load factor is, of course, much worse than this, as the average car miles of the day are much less than for the hour of maximum load. A large system ordinarily gives a daily load factor of 35 to 40 per cent.

To show the application of these figures let us assume a 50-car system of which 30 cars are 20-ton, double-truck, and 20 are 10-ton, single-truck. Let the average or schedule speed be 10 miles per hour and let us assume the average power consumption to be 135 watt-hours per ton-mile. Let us further assume that 20 double and 10 single-truck cars operate 19 hours per day; 5 double and 5 single-truck cars 5 hours, and the remainder but 3 hours per day. The total ton-miles per day will amount to 107,000, and the ton-miles during the maximum hour 8,000. Consequently the daily power consumption will be 14,445 kilowatt-hours, and that of the rush hour 1,080. If the load factor of the maximum hour be assumed to be 40 per cent., the maximum demand will amount to 2,700 kilowatts, or 54 kilowatts per car, and the daily load factor will be 35.5 per cent.

EARNINGS OF THE OAKLAND TRACTION CO.

The report of the Oakland Traction Company for 1906, just issued, shows that the traffic has almost doubled during the year, instead of increasing 15 per cent, as has been the case for several years previous. The owners of the Oakland Traction propose now to make important additions to their lines and for this purpose bonds to the amount of $12,000,000 will be issued at once, of which $7,000,000 will be held to pay off the present bonded indebtedness and $5,000,000 will be used for additional equipment and important extensions to the company's lines.

A COMPARISON OF UNIVERSITY AND INDUSTRIAL METHODS OF EDUCATION AND DISCIPLINE.*

By Mr. Frederick W. Taylor, President of the A. S. M. E.

The point from which I view college education is that of the employer, not that of the educator. I have had no experience with the difficult and complicated problem that faces the professors and the governing boards of our colleges. On the other hand, I have been engaged for years in organizing the shop, office, and commercial management of quite a wide range of engineering and manufacturing establishments. This has brought me into intimate personal contact with a large number of college graduates, and I have become well acquainted with their strong points, which are many, and at the same time with a few of those points in which it would seem that as a class they might be improved. And in what I shall say I have principally in mind the preparation of young men for success in commercial engineering and industrial enterprises; in other words, enterprises outside of the four learned professions.

I despise the pessimist who sees nothing but the defects and blunders of mankind; and the scold, whose pleasure it is to complain of all things as they are.

Let me say at the start, that without question, our college graduates as a class represent the finest body of men in the community. And as to the value of an engineering course for men in our profession, it has been shown through carefully-gathered statistics, that within a few years after graduation the college-educated engineer far outstrips in position and salary his average competitor who comes up from the ranks.

It would be a much more congenial task to dwell upon this view of the profession, but something may possibly be gained by considering what has seemed to many of the friends of our young graduates to be the one defect which they practically all have in common.

For a period of from six months to two years after graduating they are, generally speaking, discontented and unhappy. They are apt to look upon their employers as unappreciative, unjust and tyrannical, and it is frequently only after changing employers once or twice and finding the same lack of appreciation in all of them, that they finally start upon their real careers of usefulness.

On the other hand, the attitude of employers toward young graduates is fairly expressed by the following written instructions given for the selection of quite a number of young men to fill positions which presented opportunities for rapid development and advancement. These instructions were to give the preference—first, to graduates of technical schools; second, to the graduates of the academic departments; but to employ no college boy who had not been out for more than two years.

Why is it, then, that these young men are discontented and of practically little use during the first year or two after graduating?

To a certain extent this is unquestionably due to the sudden and radical change from years spent as boys almost solely in absorbing and assimilating knowledge for their own benefit to their new occupation of giving out and using what they have for the benefit of others. To a degree it is the sponge objecting to the pressure of the hand which uses it. To a greater degree, however, I believe this trouble to be due to the lack of discipline and to the lack of direct, earnest and logical purpose which accompanies, to a large extent, modern university life.

During the four years that these young men are at college they are under less discipline, and are given a greater liberty than they have ever had before or will ever have again.

As to college discipline, it cannot be a good training for after life for a young man deliberately to be told by the university authorities that he can flagrantly neglect his duties sixty times in one term before any attention will be paid to it; while, if in business, the same young man would be discharged for being absent two or three times without permission.

And, as to the freedom offered by the modern university system, it is not true that boys from eighteen to twenty years old have the knowledge and experience necessary to select a logical and well-rounded course of studies, and even if they had this wisdom, the temptation to choose those studies which come easiest is so strong that it would be unwise to throw upon them so great a responsibility. Nor does it appear wise to leave each student free to study as little or as much as may suit him, at times doing practically no work for days, and at others greatly overworking, with no restraint or direction except the round-up which comes twice a year with examinations. At the least, it must be said that in commercial or industrial life this undirected liberty will never again be allowed them.

During the past thirty years two radical changes have occurred in educational methods. The kindergarten and its accompanying ideas has come for the children, and for the young men has come the change from the college, with its one or two courses carefully selected and rigidly prescribed by the faculty, to the university with as many different courses as there are young men, and in which, under the elective system, each student is given the choice of all of his studies.

The fundamental idea back of the change from college to university is excellent; namely, that of providing a far greater variety in the courses to suit the different tastes and abilities of the students, and to especially prepare them for their future occupations. Accompanying, however, this great step in advance, and yet, so far as I can see, in no way logically connected with it, has come the false step of giving our young men in many cases a greater liberty than is allowed, on the whole, to any other class of active workers; and of handing over to them the final decision in a subject most needing a master mind.

Commercial, manufacturing, and other enterprises in which many men co-operate, are managed more and more by delegating all important decisions to a few men whose judgment has been trained through long experience, study, and observation in those matters which they are called upon to decide. Yet many of our universities are managed by giving over to the young man, under the elective system, the final decision as to what studies will best fit him for his life's work, although he has, of necessity, but the vaguest idea of the nature of the subjects which lie before him. It is almost like asking him to lift himself up by his boot straps.

I cannot but think that in changing we have modeled largely after the English and German universities, which, as we know, are influenced in their management by traditions handed down through several hundred years; and that in adopting the great university idea of a variety of courses, we have at the same time blindly accepted the foreign idea of the elective system accompanied by a lax discipline, both of which are better suited to medieval times when each man worked for himself than to the present day when the road to success lies through true co-operation.

In this change, also, too great stress has been laid upon those elements leading to knowledge or book learning on the part of the student and too little upon the development of his character.

The kindergarten also, which has proved so great a help in training the younger children, making them observant and giving them a certain control over themselves, has brought with it one idea which has wrought great harm, and yet this bad idea is in no way properly or logically connected with the underlying principles of the kindergarten.

*An address delivered at the dedication of the new engineering building of the University of Pennsylvania.

Somehow the average kindergarten child gets a firm conviction that it is the duty of the teacher to make things interesting and amusing, and from this follows soon the notion that if he does not like his studies and fails to learn much, it is largely the teacher's fault. Now, whatever views the parents or the teachers themselves should hold upon the duties of teachers, there is no doubt that the boys should have firmly in their heads the good, old-fashioned idea that it is their duty to learn, and not that it is the duty of the teacher to teach them.

Along with the kindergarten plan of interesting and amusing children, the idea has taken firm hold in a large portion of the educational world that the child and young man should be free to develop naturally, like a beautiful plant or flower. This may again be an excellent view for the older person to hold, but it is a distinctly bad one for the young man to act upon. He promptly translates the idea of development naturally into wishing to do only, or mainly, those things which he likes or which come easy to him.

Of all the habits and principles which make for success in a young man, the most useful is the determination to do and to do right all those things which come his way each day, whether they are agreeable or disagreeable; and the ability to do this is best acquired through long practice in doggedly doing along with that which is agreeable a lot of things which are tiresome and monotonous, and which one does not like.

Now neither the kindergarten idea, the university elective system, nor the lax college discipline tend to develop this all important habit in young men.

True co-operation, co-operation upon the broadest scale, is that feature which distinguishes our present commercial and industrial development from that of one hundred years ago. Not the co-operation taught by too many among those of our trades unions which are misguided, and which resembles the co-operation of a train of freight cars; but rather that of a well-organized manufacturing establishment, which is typified by the co-operation of the various parts of a watch, each member of which performs and is supreme in its own function, and yet is controlled by and must work harmoniously with many other members.

It is a mistaken notion that character of this kind needed for successful co-operation is developed by the elective idea of allowing each boy to choose for himself those things which he will do. It requires far more character to do successfully those things which are laid out for one by a wiser man than to do only what one likes, and in modern co-operation, while the work of each man is modified and more or less controlled by that of others, there is ample scope left for originality and individuality. We must remember that of all classes in the community, college boys are being trained to fill some day the position of leaders in the co-operative field. And there is no fact better established than that the man who has not learned promptly and fully to obey an order, is not fit to give one.

An examination of the studies chosen by boys in the university academic departments will show that the logic and motive back of about one-half of the students is that of obtaining an easy course, and even better students show generally a lack of clear-cut logical purpose in their selection. In their case, the studies are chosen because the young man likes or is interested in the subjects, or because they come easy to him, rather than because they give a well-rounded and balanced course with a distinct logical purpose. The loose, flabby, purposeless courses chosen by fully one-half of the students under the present system furnish but poor mental diet.

Why cannot all of the good features of the elective system be better attained by permitting each young man to choose in general the object or purpose for which he wishes to educate himself, and then leave the entire course of studies to the one or more professors in the faculty who are especially fitted to plan a complete and logical course in the chosen field? Let the young man say where he wishes to go, and let the faculty tell him the road he is to travel to get there.

As to the object of college life, some boys are sent to the university to learn how to mingle with men, and to form friendships which shall prove useful and agreeable in after life. Some go there to amuse themselves, and some to get the standing given by a college degree.

Something can be said for each of these objects. Is not the true object of all education, however, that of training boys to be successful men? I mean men successful in the broadest sense, not merely successful money getters. Successful, first in developing their own characters, and second, in doing their full share of the world's work.

Young men should not come to college mainly to get book learning or a wide knowledge of facts. The successful men of our acquaintance are, generally speaking, neither learned nor men of great intellect. They are men, first of all, possessed with an earnest purpose. They have a certain all-round poise or balance called common sense. They have acquired through long training those habits both mental and physical which make them masters over themselves; and at all times they have the firm determination to pay the price for success in hard work and self-denial.

It is singleness and earnestness of purpose that constitutes the great motive power back of most successful men, and it is a notable fact that the moment a young man becomes animated with such a purpose, that moment he ceases to believe in the elective system, and in the loose college discipline.

In all earnest enterprises which the students themselves manage, they throw the elective system to the winds, and adopt methods and a discipline quite as rigid as those prevailing in the commercial and industrial world.

The boy who joins the football squad is given no sixty cuts a season, nor is he allowed to choose what he will do. He does just what someone else tells him to do, and does it at the time and in the manner he is told, and one or two lapses from training rules are sufficient cause for expulsion from the team or the crew.

I say in all seriousness that were it not for a certain trickiness and a low professional spirit which has come to be a part of the game, I should look upon football and the training received in athletics as one of the most useful elements in a college course, for two reasons: first, because in it they are actuated by a truly serious purpose; and second, because they are there given not the elective idea of doing what they want to, but co-operation, and co-operation of the same general character which they will be called upon to practice in after life.

Is not the greatest problem in university life, then, how to animate the students with an earnest, logical purpose?

In facing this question I would call attention to one class of young men who are almost universally imbued with such a purpose; namely, those who, through necessity or otherwise, have come into close contact and direct competition with men working for a living. These young men acquire a truly earnest purpose. They see the reality of life, they have a strong foretaste of the struggle ahead of them, and they come to the university with a determination to get something practical from the college training which they can use later in their competition with men.

They are in great demand after graduating, and as a class make themselves useful almost from the day that they start in to work.

Neither their earnestness of purpose, however, nor their immediate usefulness, comes from any technical knowledge which they have acquired while working outside of the university, but rather from having early brought home to them the nature of the great problem they must face after graduating. Nothing but contact with work and actual compe-

tition with men struggling for a living will teach them this. It cannot be theorized over or lectured upon, or taught in the school workshop or laboratory.

I look upon this actual work and competition with men working for a living as of such great value in developing earnestness of purpose that it would seem to me time well spent for each student, say, at the end of the Freshman year, to be handed over by the university for a period of six months to some commercial, engineering or manufacturing establishment; there to work as an employee at whatever job is given him, either manual or other work. He should have the same hours and be under the same discipline as all other employees, and should receive no favors. Moreover, he should be obliged to stay even a longer time than six months unless he has in the meantime given satisfaction to his employers.

I believe that there would be but little difficulty in obtaining the co-operation of our business and manufacturing establishments in carrying out this plan, and the University of Pennsylvania, situated as it is in the foremost manufacturing city in this country, would have an especially good opportunity to inaugurate it.

My belief in the benefits to be derived from doing practical, every-day work early in the college course, is not the result of a theory. It is founded upon close observation and study of young men who have had this experience, and also upon a vivid remembrance of breakfasting each morning at five-thirty and starting to sweep the floor of a pattern shop as an apprentice some thirty-two years ago, after having spent several years in preparing for Harvard College. The contrast between the two occupations was great, but I look back upon the first six months of my apprenticeship as a patternmaker as, on the whole, the most valuable part of my education. Not that I gained much knowledge during that time, nor did I ever become a very good patternmaker; but the awakening as to the reality and seriousness of life was complete, and, I believe, of great value.

Unfortunately, laboratory or even shop work in the University, useful as they are, do not serve at all the same purpose, since the young man is surrounded there by other students and professors, and lacks the actual competition of men working for a living. He does not learn at college that on the whole the ordinary mechanics, and even poorly educated workmen, are naturally about as smart as he is, and that his best way to rise above them lies in getting his mind more thoroughly trained than theirs, and in learning things they do not know. All of this should be taught him through six months' contact with workingmen.

Let me repeat, in conclusion, that our college graduates are the best-picked body of men in the community. Yet I believe that it is possible to so train young men that they will be useful to their employers almost from the day that they leave college; so that they will be reasonably satisfied with their new work, instead of discontented; and to place them, upon graduating, one or two years nearer success than they now are; and that this can best be accomplished by giving them an earnest purpose through six months' contact early in their college life with men working for a living; by rigidly prescribing a course of studies carefully and logically selected, and with some definite object in view, and by subjecting them to a discipline comparable with that adopted by the rest of the world.

Philadelphia possesses and is proud of the most notable group of medical schools in this country, and among these that of the University of Pennsylvania unquestionably stands first.

The Philadelphia lawyer has been proverbial for his knowledge and shrewdness for more than a century, and this reputation can be traced largely to the fundamental training given in the law school of the University of Pennsylvania.

Philadelphia is the center of the largest and most diversified group of engineering and manufacturing enterprises in this country. The Engineering Schools of the University of Pennsylvania already stand high; but it seems to me that the opportunity lies open to them even more than to their famous medical and law schools to stand at the very top. This magnificent building, equipped as it is with the latest and best of everything, is the first and a great step toward this end. But, after all, your largest possibility, and one which does not exist for and cannot be created by any other American university, lies in the opportunity for bringing your students into close touch and personal contact with the men who are working in and managing the great industrial establishments of Philadelphia.

THE LARGEST LOCOMOTIVE IN THE WORLD.*

Thomas F. Crawford.

James J. Hill, president of the Great Northern Railway Line, and commonly known as the "Empire Builder of the Northwest," has long been noted as a seeker of things that are big. His ships are the biggest on the Pacific Ocean, his ore docks at Allouez are the largest in the world, as is also his grain elevator at Superior, Wisconsin; and now he is the possessor of the five largest locomotives ever constructed.

These were built by the Baldwin Locomotive Works, of Philadelphia, during the past summer, and represent the most modern ideas and practice employed in this or any other country at the present time. As a machine the locomotive has always been of interest to the layman, as well as the mechanic, and this latest product is of more than ordinary interest, owing to the fact that it illustrates a radical departure in locomotive building that is as yet in its infancy as far as this part of the world is concerned; namely, the "Articulated (Mallet) Compound" design.

Scarcely a railroad in this country can boast of a line that does not require a pusher engine, at some point, in order to get the regulation freight trains up the grades. If "pusher engines" are not used it is necessary to double over, by cutting the train in two, so that in either case much valuable time is lost and extra expense incurred. This condition is more decided in the West and Northwest, where the Rocky and Cascade mountains form an almost impassable barrier. Often it is necessary to double head in front and have a pusher behind in order to move a train that on a level track would require but one heavy freight engine. This fact has long been troubling the officials of every important road, more especially where the competition is heavy and any slight extra expense immediately affects the dividend-paying power of the road.

Locomotive designers have spent much time in working up compound and other steam-saving devices, but the problem remained unsolved; until finally they were compelled to take up what had been used in foreign countries for many years, at last bringing the Mallet Compound idea to the United States. A little more than two years ago the American Locomotive Company brought out the first American adaptation of the principle, in a locomotive built for the Baltimore and Ohio R. R. This locomotive was at that time the largest ever built and its performance has been watched with utmost interest by motive power officials in every section of the United States. Much literature has been published regarding the work that this engine has done on the heavy grades over the mountains near Cumberland, Maryland, and as a general rule the reports have been exceedingly favorable, justifying the introduction of such a type in this country.

*Reprinted from the "Sibley Journal of Engineering," Cornell University.

The locomotive itself is essentially two separate machines operating under one boiler; one engine working high-pressure steam direct from the boiler; and the other working low pressure as exhausted from the high pressure. The advantage of this independent compounding is readily seen, for the enormous weight of the boiler and other parts is distributed over an extremely large driving wheel base which in itself means increased power. The tractive power or ability of a locomotive to pull depends entirely upon the adhesion of the wheels to the rail, and consequently the power is directly governed by the weight supported by the driving wheels.

With ordinary single-expansion or compound locomotives there is a certain limit; cylinder diameter may be enlarged and boiler pressure increased above this, but all is wasted for the greater power simply causes the driving wheels to slip violently without moving ahead as the tractive power now exceeds the adhesion. With the Mallet Compound, however, this is different for the great weight is supported by many driving wheels extending over a large distance, which permits of extra large cylinders, in fact the tractive power of this type is almost double that of the ordinary "Consolidation" type that is now almost universally used for freight service.

The following formula for simple and compound locomotives, published by the Baldwin Locomotive Works, will show clearly the relation of tractive power to cylinder diameter and boiler pressure. It also shows that the smaller in diameter the wheels the greater the power; this explains the small wheels usually found on freight locomotives. In this connection it is interesting to note that the locomotive is one of the few machines that becomes more powerful the more it wears, for with every mile of service the tires are worn to some extent, soon resulting in an appreciable reduction in diameter which results in increased tractive power, as will be seen from the formula:

$$\text{Tractive Power (simple eng.)} = \frac{C^2 \times S \times P}{D}$$

$$\text{Tractive power (compound eng.)} \begin{cases} = \dfrac{C^2 \times S \times \frac{3}{5} P}{D} \\ \dfrac{c^2 \times S \times \frac{1}{4} P}{D} \end{cases}$$

C diameter of high-pressure cylinder in inches.
c diameter of low-pressure cylinder in inches.
S stroke of piston in inches.
P mean effective pressure in pounds (usually 85 per cent. boiler pressure).
D diameter of driving wheels in inches.

Another excellent feature of the Mallet design is the distribution of the strains in the rods, pins, etc., due to the fact that the power is transmitted to four crank pins instead of two, as in the ordinary locomotive. The American Balanced compound is another recent example of this distribution of strains. For sharp curves the Mallet type is also quite adaptable, owing to the short, rigid wheel base; in this case, 10 feet. At a first glance it would seem as if the whole boiler rode on one rigid frame, but such is not the case. Just in front of the high-pressure or middle pair of cylinders, the frame is joined together by means of a pin connection which allows the forward set of wheels to move freely as though they were merely a large truck. The locomotive in use on the B. & O. is said to have ridden easily on curves up to 22 degrees.

The high-pressure cylinder casting is bolted to the shell of the boiler but the low-pressure cylinders in front are simply connected to the frame, the weight being held up in front by a small truck wheel not found in the original B. & O. design. The weight of the front end of the boiler is transmitted to the frames by means of a sliding bearing or shoe, which is connected to the boiler and slips from side to side across the frame.

Another foreign feature on this engine, and now being introduced in this country, is the Walschaert Valve gear, which is located in plain sight outside the wheels. This motion is fast becoming popular and already has been adopted as standard by three of the leading trunk lines. With this type of engine it is almost a necessity, owing to the need of inside frame space for bracing and other features.

The Great Northern engines are all in use on the Cascade Mountains, where it has always been extremely difficult to move heavy freights. No records are as yet obtainable, but should the five locomotives now in service prove as successful as that operated on the B. & O., there is no reason why all lines operating through the mountain regions should not adopt the new idea. The mere saving in labor alone will amount to many dollars, for the Mallet will operate with one engineer and fireman and do the work of two engines, thus saving $8.50 per day or about $3,100 per year.

The following are the dimensions of this, the largest locomotive in the world:

Total weight of engine alone	355,000 lbs.
Total weight engine and tank	503,000 lbs.
Total length engine and tank	83 ft. 7¼ ins.
Diameter of cylinders..(H.P. 21½ ins.) (L.P. 33 ins)	
Stroke of piston	32 ins.
Diameter of drivers	56 ins.
Diameter of boiler	84 ins.
Steam pressure	200 lbs.
Total heating surface	5700 sq. ft.
Total grate surface	78 sq. ft.
Number of tubes	442—2¼ ins. diameter
Tractive power	71,540 lbs.

POWER AND LIGHTING RATES OF THE JAMESTOWN EXPOSITION.

The rate for electric service at the Jamestown exposition, which will open at Hampton roads on April 26 of next year, are as follows:

Rates for Light Service.

100 kilowatt hours or less, 10 cents per kilowatt hour; 101 to 280 kilowatt hours, 9 cents per kilowatt hour; 281 to 625 kilowatt hours, 8 cents per kilowatt hour; 626 to 1,430 kilowatt hours, 7 cents per kilowatt hour; 1,431 and above kilowatt hours, 6 cents per kilowatt hour.

Rates for Power Service.

115 kilowatt hours or less, 9 cents per kilowatt hour; 116 to 360 kilowatt hours, 7 cents per kilowatt hour; 361 to 770 kilowatt hours, 6½ cents per kilowatt hour; 771 to 1,365 kilowatt hours, 5½ cents per kilowatt hour; 1,366 to 2,225 kilowatt hours, 4½ cents per kilowatt hour; 2,226 and above kilowatt hours, 4 cents per kilowatt hour.

The exposition company will make all necessary connections from the exposition service main to the main switch and fuses installed by the consumer, together with all necessary meters and apparatus for measuring the current consumed, at the consumer's expense. Alternating current at a frequency of 60 cycles and at approximately 110 volts will be furnished for lighting purposes on the entire ground. On the War-path direct current of the same voltage will be also available. For the power service direct current at approximately 500 volts will be furnished, but special arrangements may be made with the department of electricity for furnishing alternating current for small motors.

The rates above given are subject to a discount of ten per cent. for prompt payment, and are, of course, subject to the terms of any special contract which a consumer may execute.

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Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," with which is incorporated "The Engineers', Architects' and Builders' News."
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Entry changed to "The Journal of Electricity," September, 1895.

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EDITORIAL.

The Cable and The Trolley

Mr. Andrew S. Hallidie, of San Francisco, invented and perfected the cable street railway system, as it was first introduced on Clay Street, in this city, more than a quarter of a century ago. While having been devised primarily for heavy grades, such as even today exist on many of San Francisco's principal streets, but a few years after the installation in the Pacific Coast city, the horse cars of Chicago were replaced by cable lines, although the streets of the latter city are remarkably level. The convenience of control and the adaptability of the cable for city streets was thus early recognized, and the original ideas of the inventor were extended to the general use of the cable for city street railway service.

During the next few years, the cable road was introduced in Cincinnati, Kansas City, Philadelphia, New York City and Washington, D. C., very nearly in the order named. Other small cities, principally on the Pacific Coast, such as Los Angeles, Oakland, San Jose and Seattle had in the meantime installed cable street railway systems.

From its first introduction in San Francisco in 1873, the cable road had a rapid and steady growth until about 1895. Near the latter date the total length of all of the lines in operation in San Francisco alone was about one hundred miles, many of the grades being in excess of 16 per cent. Probably in the aggregate there were in the United States at that time between seven and eight hundred miles of cable street railway in operation.

New York City, between 1895 and 1899, after practically every other city had either abandoned cable railway extensions or actually replaced the old cable lines with the electric trolley, built and put in operation more than fifty miles of cable street railway lines. But a few years elapsed, however, before the first city in the United States began to abandon its cable roads in favor of more rapid transportation systems.

For the largest cities on the busiest and most crowded thoroughfares, the cable car has many advantages. The speed is practically fixed, no matter what the grade of the track or the load on the car may be, but this speed can rarely be made to exceed twelve miles an hour, which practically excludes the cable for suburban or residence traffic.

There can be no question that the cable road, even today, would be increasing in popularity and new lines under construction if it were not for the introduction and general development of the electric street railway system, which is almost exclusively the trolley system. While in a different way than was the case in other cities, San Francisco has had an opportunity since last April of comparing the efficiency of the electric street car and its predecessor, the cable car. Due, it must be admitted, to abnormal conditions, there is today in San Francisco but a very few miles of cable road in operation. Beginning with approximately ten years ago, all new street railway construction in San Francisco was of the electric trolley system, and the very rapid growth of the suburbs of San Francisco is undoubtedly due to the extensive introduction of the electric trolley system.

The adaptability of the trolley to San Francisco's principal streets is a matter of great importance. When the city is rebuilt, would it be advisable to have the electric trolley system in use on such thoroughfares as Market St., Van Ness Ave., Kearny St., Sutter St., and in fact all of the business streets in the retail and wholesale districts? It is quite certain that the congested traffic, which seems unavoidable at the present time, would be even more serious than it is were it not for the substitution of the electric trolley system for the old cable lines. The San Francisco of the future, however, should undoubtedly be a city without down-town surface roads, particularly on its principal thoroughfares, and during the few years of reconstruction it may be advisable to continue the use of the electric trolley, rather than go back to the old cable system.

For outlying districts, there can be no question that the overhead electric trolley is the only system which can be practically installed, taking the cost of construction and speed requirements into consideration. For the congested portions of the city, the entire elimination of the surface roads would undoubtedly be preferable to even the use of the underground conduit electric system.

CORN HARVESTING MACHINERY.

The United States Department of Agriculture has recently issued Bulletin No. 173, entitled "The Evolution of Corn Harvesting Machinery," by C. J. Zintheo.

In the principal corn-growing regions of the United States, as a rule only the grain is harvested, the stalks being left in the field to be eaten by live stock, or raked and burned. It is estimated that in this way nearly one-half the food value of the corn plant is wasted. This bulletin describes the various machines which have been developed for harvesting the corn plant and preparing it for stock feed. It gives statements of cost, the length of service which may be expected under ordinary conditions, and the work which can be done with the various machines.

Application for this bulletin should be made to the Director of the Office of Experiment Stations, Washington, D. C.

TRADE CATALOGUES.

Pass & Seymour, Inc., Solvay, N. Y., have gotten out an unusually attractive little booklet telling about P. & S. incandescent lamp sockets. The covers are a bright red and are embossed in black and gold, producing a striking effect.

The H. W. Johns-Manville Co., which has branches in all large cities, points out the merits of its "Transite" asbestos doors in a small folder. Transite is a fireproof sheathing made principally of asbestos fibre, and may be cut, nailed or screwed very much the same as ordinary lumber. The doors are used in connection with fireproof walls for protection from high-tension transformers and switches.

The Crocker-Wheeler Company, of Ampere, N. J., is distributing a 1907 calendar, showing a view, printed in colors, of the main office and works of the company, where its electric motors, generators, transformers, etc., are designed and built. The calendar is a good example of lithographic work, and gives an impression of the magnitude and attractive surroundings of the Crocker-Wheeler works.

A list of electrical fittings, which have been examined and approved by the Underwriters' National Electrical Association, is given in the 1906 edition of "Electrocraft," published by the Electrocraft Publishing Co., Detroit, Mich. This is a 185-page catalogue containing illustrations, with name and address of manufacturer, of attachment plugs, bushings, conduits, cabinets, switches, fuses, sockets and other electrical fittings.

"The Booster" for December, published quarterly by the Co-operative Electrical Development Association, contains some real live talk tending to stir the central station manager to a realization that there is much new business to be obtained by energetic advertising and soliciting. There is also an outline of the good work already accomplished by the Association in its endeavors to promote the sale of electricity for commercial and domestic purposes.

The possible use of induction motors for a wide range of industrial purposes is admirably shown in Bulletin No. 1040 (revised edition), recently issued by the Electrical Department of the Allis-Chalmers Co. Types for the various uses are shown with methods of installing same. Dimension data for standard sizes is also given.

PERSONAL.

Mr. Harry C. Rice, vice-president of the General Incandescent Lamp Co., of Cleveland, has favored the Coast with a visit in the interest of the trade. This company is now engaged in the manufacture of incandescent lamps exclusively.

Mr. Rice will visit Los Angeles and other Coast cities before returning east.

"THE ILLUMINATING ENGINEER,"

published by the Illuminating Engineering Pub. Co., announces the removal of its publication offices from 25 Broad Street to larger and more centrally located quarters at 12 West 40th Street, opposite New York Public Library.

A SUCCESSFUL TEST.

Professor Durand, of Stanford University, recently made a test of the steam power plant of the Home Gas and Electric Company, of Redlands, California. This test was to determine the forfeit or bonus, as the contractor guaranteed the kilowatt output at the switchboard per barrel of fuel oil. This guarantee was exceptionally high, but it is reported that the results have so far exceeded the guarantee as to set a new standard in the economical development of power with oil as a fuel.

This plant was designed and built by The Tracy Engineering Company, who make a specialty of economy power plants.

AN UNIQUE NATURAL PRODUCT.

One of Nature's most wonderful and unique products is Asbestos, a material which, in spite of its extensive use, is comparatively unknown to the general public. Prior to 1850, it was looked upon principally as a curiosity, although Charlemagne (Roman Emperor from 800 to 814 A. D.) is said to have had a table cloth made of Asbestos, which he cleaned by throwing into fire.

There are two varieties of commercial asbestos, known as Amphibole and Chrysotile. The former is used only to a comparatively small extent, as the fibres are short and without tensile strength, and are therefore not suitable for manufacturing many of the asbestos products. Amphibole is used to some extent in cements, but is not well adapted even for that purpose. Chrysotile, on the other hand, has a strong and silky fibre, which adapts it for such materials as asbestos fabrics, household utensils, theater curtains, clothing for firemen, etc.

In Germany, asbestos is known as steinflachs (stone flax) and the miners of Quebec give it quite as expressive a name—pierre cotton (cotton stone).

Asbestos is mined in open pits, similar to stone quarries, and although it is found in all parts of the world, the mines in Quebec, Canada, are the most famous, yielding about 85 per cent. of the world's supply of chrysotile. Probably the largest of these mines is that owned by the H. W. Johns-Manville Co., of New York. In 1879 the output of the Quebec mines was 300 tons, which has steadily increased, year by year, to 50,000 tons in 1905.

SEEING BY ELECTRICITY.

Almost at the same time two different inventors in different places have announced their success with electrical devices for seeing at a distance. They are J. B. Fowler and William H. Tompson. In Fowler's device four wires are required to accomplish the combined effect of distant vision and hearing. Details of the operation are withheld, however, on the plea of getting out a patent. Each inventor has adopted the name "Televue."

GREAT WATER POWER PROJECT.

Former Governor Herrick, of Ohio, and Thomas F. Walsh, of Denver, have formed a $9,000,000 syndicate for the purpose of harnessing the mountain streams of the Rockies for long-distance transmission, so as to revolutionize western industries. John Hayes Hammond has been employed as chief engineer. Herrick predicts that in ten years every railroad crossing the mountains will use electrical power generated by falling water.

AN AMERICAN'S IMPRESSION OF EUROPE.

In a letter which we have just received from Berlin, Mr. E. N. Percy comments vigorously on the national characteristics of the leading European countries, taking the point of view of the American engineer. Mr. Percy writes as follows:

"The French are not great theorists, but they like to construct wonderful and delicate mechanisms. The French workman takes great pride in the exquisiteness of a piece of work, spending more time, for instance, on the appearance and finish of an automobile engine than on its strength and hardiness. Their machinery looks as though it had been designed by a lacemaker or an artist, rather than by an engineer. They are always making experimental machinery on a large and costly scale. For instance, they recently made a huge turbine air compressor run by a Parson's turbine. The assumptions were evidently in error, for it turned out to have a very low efficiency. This would have been impossible in Germany; for if the efficiency could not have been forecast by mathematics, the turbine would never have been built.

"England is an intensely practical nation, and one finds few highly technical men. They have no patience with analysis; they want to 'do' things. For this reason English methods are a bit backward. Men seldom work as hard here as in America. They count on making their jobs last as long as possible, and resent the influx of any labor-saving machinery whatever. They drink more than is really healthful, and have numerous holidays and labor troubles interfere with the execution of work. There is nothing active, new or progressive about the average English shop; there is the same dull routine.

"The Scotch shops are very different. Here we see good, hard-working mechanics and men who know their business thoroughly; but they are too conservative, and hence there is comparatively little encouragement for new ideas. For that matter, outside of America no country offers any great financial inducements for the introduction of new methods. Japan is very progressive, but foreigners can not realize anything on their inventions as there is no patent protection in this country.

"In Germany we find education to be a colossal monument of theory. On graduation from the gymnasium a young man is about twenty-three or four years old; he has a high-school education and is just ready to enter the technical school. After from five to seven years here he is thrown out into the world to make his living—an inefficient man of thirty years or more and the best part of his life gone. He is, if he has been a conscientious student, bald-headed, weak-eyed, without personality, knows nothing of the world nor of meeting people, knows nothing of business nor many things which are familiar to an American boy ten years his junior, who is taking the same course. For instance, here a graduate in mechanical engineering knows nothing whatever about surveying or foundation work. He has never taken an outdoor measurement. The civil engineer knows all about the chemistry of concrete and cement, yet he hears not one word about the machinery for making these. He starts to work for $25.00 to $30.00 a month, if he can get a job. Young men are trusted with nothing here. The writer (who boasts about thirty years) had some difficulty in convincing a manufacturer that he actually had been trusted to buy and sell machinery for an American firm.

"Not long ago it was desirable to determine the size and shape of a steam turbine nozzle. Acres of paper had been covered with calculations and acres more were to be covered. A professor arrived from America. He arranged a jet of steam so as to discharge into a vacuum, photographed the jet and measured it, and the problem was solved while German eyes looked on with astonishment.

"At the universities there is no fellowship with the professors. Their dignity and the social pedestal upon which they stand prevents all intercourse. There is no student body organization and no college life, if the duelling and drinking corps be excepted.

"Physicians and chemists constitute Germany's prize technical men. As to physicians, the writer seriously believes, from knowledge gained through personal acquaintance with most members of the American Physicians' Club in Berlin, that America's medical men are just as wise and far more skillful as surgeons. They come here because they are ignorant of existing conditions in order to obtain the prestige and knowledge supposed to be available. Another inducement is that there is so much material here to practice on.

"In Germany, no matter what a physician does to a patient, there is no redress by law. There is an immense number of poor people who receive free treatment from physicians making their living entirely by teaching others. They are often cruel to these patients; cases have come to the writer's attention of operations performed without the use of anesthetics, as well as operations in the nose with instruments that were too large, thus causing pain and injury for the sake of observing the scientific result. Dying patients are neglected and physicians talk in their hearing of the probable results of the post-mortem. This is not said out of malice, but to show that the nation is scientific above everything, even the heart.

"The railroads here are owned by the government. They are said to pay an immense revenue and to be self-supporting; and strikes are unknown. However, if this is a sample of government ownership, the writer does not care to see it established in the states. The railroad civil engineering specialist is almost unknown here, and a ride over the road gives one no reason to doubt the statement. The road beds are elevated in nearly all cities, and the block system is universal, but the rails are light and the road bed rough. The stations are all very complete, and the locomotives are economical, with patent valve gears, but are light and slow, there are no fast trains; the fastest not making 50 miles per hour, and the rolling and pitching can only be equalled by some of our Colorado railroads. Locals are unbearably slow, making ten or fifteen miles per hour. All cars are light, and have but two trucks each. Also, the short cars and all freight cars have only four wheels, all told—like a toy street car. Their largest freight car is smaller than a furniture van in San Francisco.

"All of the employees are uniformed, and military discipline prevails. The engineer does not wear overalls, but a gorgeous uniform; and the magnificently accoutred conductor is not a paragon of virtue, but a mere man, who for twenty cents will reverse the sign on the door of your compartment, changing it to first class, which indicates that no one else can come in. First class in this country is a privilege. It means that you have the place to yourself. In the second class compartment, the public can enter until it is full, although it is a duplicate of the first-class compartment. A man can do wonders with a few cigars. By handing them around you make friends; by smoking them, you secure undisputed possession of the compartment; at least, that was the writer's experience. It might be well to add that he cannot afford to smoke the brand he keeps for his friends; hence the above judicious use of difference in brand.

"All power-developing machinery must be the most efficient possible, as fuel is very expensive, and the conditions of the country are such that the capitalist is satisfied with a small, sure interest on a large investment. The principal steam turbines in use are the Stumpf, made by the local 'Allgemeine Electrische Gesellschaft,' and the Sulzer turbine, made by that well-known firm.

"A great deal of American tool machinery is imported here. There is a great field for labor-saving machinery, and for such things as we can manufacture at competitive prices. Germany does not produce enough to support herself, so she is preparing to market her skill. Germany will not surpass nor even equal us in originality, any more than an old man can surpass a young man; nor can she produce what she does not have; but Germany is persistent and never takes her eye off the goal. She will surpass and pass us in manufactures (even with our machinery); she will get our foreign market, because we are now neglecting it; she will excel us on the seas, because she aims to become a sea power commercially. Among some of the brightest men in the world are Germany's statesmen and her Emperor.

"She stands at the head of the world in the manufacture of gas engines, and the largest firms in our country are manufacturing these from German patents. The Koerting and Nurnberg are examples, also the Diesel, the Mietz and Wiess. On the other hand, the slowness of the country in many ways is discouraging to those few live heads who would awaken it. Every day nearly every bank, business house, and shop in the country closes down from one o'clock until three or four, and one can transact no business. All workmen have their tea or beer several times a day, and with their slow methods, their holidays, frequent beers and refreshments the German workman accomplishes less in his day of twelve or fourteen hours than the American workman.

"The German automobiles are among the best in the world, but they cost far more than the American, notwithstanding that labor is cheaper. They produce a car that runs easily and very efficiently with a small engine. We put in an engine that burns more oil, but we put in a vaporizer that uses crude distillate at one-fourth the price of gasoline, an idea which the German never thought of.

"The German engineers say that we are not scientific, but money mad. One of them said that he worked with a pure scientific interest, and would not be swayed from his work by any mere monetary consideration. A fine position was offered him in America, at a greater salary, but with no scientific opportunity whatever. There is a vacancy here now for some man of scientific tastes who does not want too much money. (The position is still vacant.) We may be money mad, but I have seen the cause of our madness curve many a Teuton back. Money will not make a German hurry for the simple reason that it is impossible for him to hurry about anything; hence it is not strange that he does not run for it; but the writer has seen the porter of an engineering plant disobey his master's orders, neglect his duties, and take the writer through the plant by byways, and tire himself out with anxiety because twenty cents of good American money lay in his pocket and twenty more were to come. The writer has been in China, Japan, Honolulu, France, Canada, Belgium, Holland and other countries, and has yet to see a country that will not fall over itself to get hold of an American dollar.

"A man cannot get a position in Germany, except he be very well educated. The Royal Technical School in Charlottenburg, a suburb of Berlin, stands at the head of Germany's technical institutions. In this country may be found many technical schools of all kinds, but this one is acknowledged the best theoretical institute of technology in the world. Here are Professors Riedler, Stumpf, Josse and others who are famous all over the world. Riedler is known for his compressors and express pumps; Stumpf for his steam turbine work in Chicago; and Josse for his waste heat engine, actually constructed and successfully running in the school laboratory. Riedler was the original designer of the Nurnberg gas engine. At this school also are the men who design a large part of the German Navy and the passenger steamers. The Kaiser Wilhelm der Grosse was designed here.

"Here are conducted experiments in gas turbines, wireless telegraphy and other scientific subjects. About four thousand students can be accommodated, and the place includes many interesting features. The Kaiser comes here occasionally.

"Certainly, Germany excels in that class of machinery requiring great theoretical investigation and careful experimental construction. This would and does include steam turbines, centrifugal pumps, water turbines, gas turbines, turbine air compressors, gas engines, gas producers, waste heat engines, super heaters, etc."

THE OPERATION OF ALTERNATING CURRENT GENERATORS.*

Electrical machinery which has been exposed to a low temperature, should not be unpacked until it has reached the temperature of the surrounding air, as otherwise a film of moisture may form on the cold surfaces due to condensation. Alternators, particularly, should be dried out by short-circuiting the armature terminals and running the machine with a low field excitation sufficient to circulate in the armature current about 25 per cent greater than normal full load current. An armature should be used to indicate the current, and the machine run until it has become thoroughly warmed up and until all moisture is evaporated.

Before an alternator, not intended to be operated in parallel with other machines, is started, one should see that the oil rings are revolving freely, that all resistance in both exciter and alternator field rheostats is cut in, and that both field and main switches are open. The alternator and exciter should be brought up to speed gradually, and resistance in the exciter field cut out until the exciter pressure is up to its normal value. The field switch of the alternator can then be closed with all resistance in, so that full voltage will not be generated in the windings. In case the machine is being started for the first time, it should be allowed to run for an hour or two at low voltage and then the voltage gradually increased until it reaches normal; the load can then be thrown on. As the load increases it will be necessary to cut out some resistance in the field circuit in order to maintain full voltage, and if the load on the alternator is inductive a larger amount of resistance must be cut out than with a non-inductive load. On light loads comparatively small field excitation is required, and it is advisable to run the exciter at rather low voltage and avoid wasting so much power in the field rheostat, provided the exciter voltage is not made low enough to render the operation unstable or cause sparking at the brushes, and that the exciter is not used for exciting other alternators.

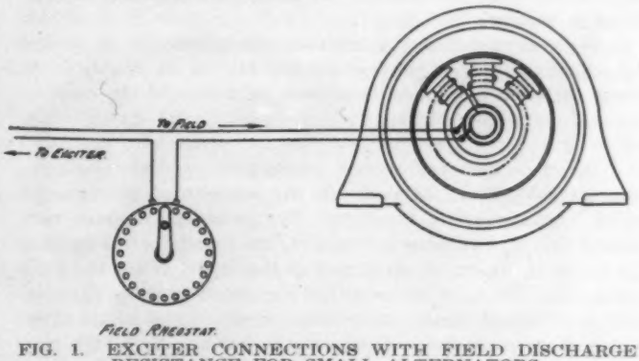

FIG. 1. EXCITER CONNECTIONS WITH FIELD DISCHARGE RESISTANCE FOR SMALL ALTERNATORS.

(*The installation of alternating current generators was discussed in the January 5th issue of the "Journal." The information given in the present article, as well as that contained in the preceding one, was very kindly supplied by the Allis-Chalmers Co.—Ed.)

To shut down an alternator running by itself, first cut in resistance in the field, thus lowering the voltage. Then open the main switch and finally the field switch of the alternator. The alternator field circuit should not be opened when full current is flowing, because the high induced E. M. F. caused thereby may be sufficient to break down the field insulation. With most large machines of the Allis-Chalmers Co. a grid resistance is connected to the field switch so that in case the latter is opened the resistance is first connected across the field circuit, thus forming a path through which the induced current can flow and prevent any abnormal rise in E. M. F. Fig. 1 shows the exciter connections for small machines, and Fig. 2 for larger alternators where a grid discharge resistance is used.

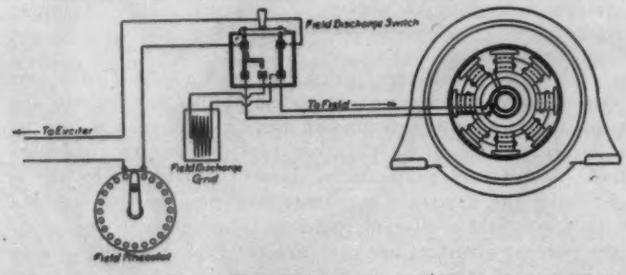

FIG. 2. EXCITER CONNECTIONS WITH GRID DISCHARGE RESISTANCE.

When two or more alternators are run in parallel there are certain conditions that must be met in order to secure satisfactory operation. These are:

(a.) The machine must be in synchronism. That is, the frequency must be the same for each, and the E. M. F.'s of the different machines must he in phase.

(b.) The E. M. F.'s must be approximately equal.

(c.) In order to secure proper division of the load under changes in load conditions, the speed regulation of the prime movers must be alike.

(d.) To prevent periodic cross currents between machines the variations in angular velocity of the prime movers must be kept within certain limits. In water-wheel or steam-turbine driven units the angular velocity is uniform, but with reciprocating engine units there may be trouble due to periodic variation if the engine fly-wheels are not heavy enough.

With belted alternators it is very important that the pulleys be proportioned so as to make the speeds of the alternators such that they will give exactly the same frequency; if all the machines have the same number of poles their speeds must be exactly alike. If the pulleys are not of the proper size there will be excessive belt slippage or exchange of cross currents between the machines, thus causing fluctuations in voltage.

With engine-driven alternators the speed can be varied by adjusting the governor, and there will be no trouble from cross currents, provided the angular velocities of the engines do not vary too much, and the engine governors act properly.

When two alternators are running in parallel their output (actual power) depends on the amount of power supplied by their prime movers. For example, suppose two engine-driven machines are running in parallel on a certain load, and that each is taking half of the load. When the load increases there is a tendency for the speed to drop slightly, and in order for the engine governors to act and admit more steam there must be a slight drop in speed. Now, the two alternators must always run in synchronism, or at the same speed, assuming the number of poles to be alike, and if the drop in speed does not result in an equal increase in the steam admission of each engine, one alternator will be supplied with more power than the other, and the load will become unequally divided. Changing the field excitation of the slightly loaded machine will not remedy matters (as with direct current generators where the generators do not have to run in synchronism and have independent speeds). The only effect of changing the field excitation is to make a wattless current circulate between the two alternators, the actual amount of power supplied by each remaining the same. The only way to increase the steam admission is by adjusting the engine governor, and to secure equal division of load under all conditions the change in speed for a given change in load must be alike for each engine. When two or more alternators are run in parallel it is advisable to have an indicating wattmeter on each machine, so that the actual load will be known. In case wattmeters are not provided the load on each should be adjusted so that the sum of the currents as indicated by the machine ammeters will be a minimum for a given total current supplied to the line. If the sum of the machine currents is much in excess of the line current it shows that a wattless current is circulating between the machines.

Synchronizing of Alternators.

The condition of synchronism is usually indicated either by incandescent lamps, or by a synchronism indicator or synchroscope, the latter now being used in most large installations. A synchroscope gives more accurate indications than lamps, and has the additional advantage of showing whether the machine is coming into or going out of phase, and how much it is out of phase.

Fig. 3 shows diagrammatically the connections for synchronizing lamps. Two small transformers A and B have their primaries connected to the same phase of each generator. The secondaries C and D are connected in series through a plug or switch p, and lamps KL. Assuming that corresponding terminals of the primaries are connected to corresponding lines on each machine, and that the two transformers are alike in every particular, corresponding secondary terminals will, at any given instant, have the same polarity when the two machines are in phase. When plug p is inserted, secondary terminals of opposite polarity are connected together; hence the two secondary E. M. F.'s are in series and aid each other in forcing current through lamps KL, which are, therefore, bright at synchronism. It may happen that the transformers are not wound exactly alike

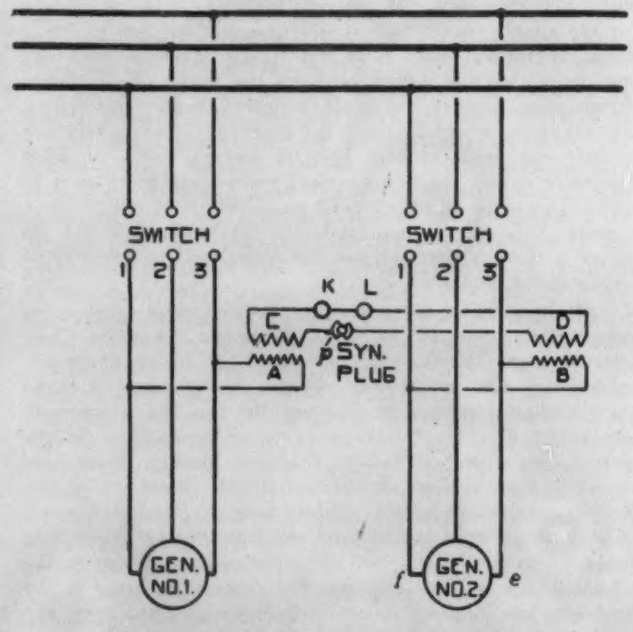

FIG. 3. CONNECTIONS FOR SYNCHRONIZING LAMPS.

or that the connections have become confused; it is always advisable, therefore, to test the connections to make sure that the lamps are light or dark at synchronism. To test the connections in Fig. 3, disconnect B from Gen. No. 2 and transfer the connections, without changing their relative position, to lines 1 and 3 of Gen. No. 1; A and B will then be connected to the same lines, and if the lamps are bright, they will also be bright at synchronism where B is connected to Gen. No. 2 as shown. If dark lamps are preferred, either the primary or secondary connections of one transformer must be reversed.

Another method of testing the connections is to leave the transformer connections as they are and disconnect the main leads (e. f.) on Gen. No. 2. Both main generator switches are then closed, thus connecting both transformers A and B to Gen. No. 1. In synchronizing, bright lamps are to be preferred to dark ones.

When a polyphase alternator is first connected up it is very important to see that all of its phases correspond with those of the bus-bars; if one phase only of a three-phase machine is correct, it does not follow that the other two are correct also. Two of the phases should be tested at the same time by using a pair of auxiliary transformers in addition to the regular synchronizing transformers AB, Fig 4. Transformer A is connected to the bus-bars, and B to the generator. A second pair of transformers CD is connected to one of the other phases, the connections in each case being such that the lamps are bright at synchronism. The connections should be tested as described above to make sure that the polarity of the transformers is correct. With

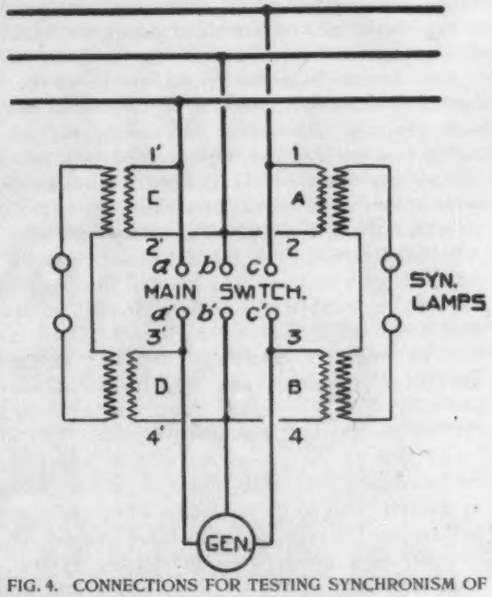

FIG. 4. CONNECTIONS FOR TESTING SYNCHRONISM OF POLYPHASE ALTENATOR.

the main switch open and with the generator running at full voltage, both sets of synchronizing lamps should pulsate together. If they do not do so the leads from the generator are incorrectly connected to the generator terminals, and should be interchanged so as to make the lamps pulsate together. After this test has been made, to insure that terminals a, b, c, connected to the bus-bars correspond to a', b', c', connected to the generator, the temporary transformers CD can be removed.

When a belted alternator is to be thrown in parallel with another machine, first bring the incoming generator up to speed and adjust the voltage until it is approximately the same as that of the bus-bars. Adjust the speed until the beats of the synchronizing lamps become very slow, say one beat in two or three seconds, or until the pointer of the synchroscope is moving very slowly. Close the main switch when the lamps indicate synchronism (lights light or dark depending on the connections), or when the pointer of the synchroscope is over the central point or slightly ahead of it. Adjust the field excitation and see that the alternator is supplied with enough power to make it carry its share of the load. In case a number of belted alternators are driven from a common line shaft, the belt of the incoming machine should be slackened, thus introducing enough slip to allow the machine to be synchronized. After the alternator is in step, the belt can be tightened and the load gradually applied.

With engine-driven alternators the incoming machine should be given only a small amount of steam until after it is synchronized. The load can then be taken up by admitting more steam. In large plants the engine governor is usually arranged so that it can be controlled electrically from the switchboard and the steam admission varied as desired. If the governor cannot be so controlled the steam admission can be regulated at the throttle. Water-wheel governors are also frequently provided with an electrical control device; if not, the gate opening must be controlled by hand to synchronize the machine and adjust the load.

When machines are operated in parallel and one is to be shut down, first reduce the load by throttling the engine or slackening the belt. Then open the main switch. Cut in resistance in the field of the alternator to reduce the field current, and open the field switch.

General Care of Alternators.

On account of not having a commutator, alternators are on the whole easier to keep in good running order than direct-current machines. At the same time they must be properly attended to. It must be remembered that they frequently generate much higher pressure than direct-current machines, and there is all the more necessity for keeping them perfectly clean. No dirt, copper or carbon dust should be allowed to accumulate on or near the windings, and in plants sufficiently large to warrant the expense, it is advisable to install a compressed air system so that all dirt can be blown out of the corners not otherwise easily reached. It is also advisable to give the armature coils and connections a coat of insulating varnish occasionally.

The collector rings should be kept lubricated with a small quantity of vaseline applied with a cloth, and the brushes should make good contact with the rings. The field circuit ought never to be opened suddenly while the current is flowing, and both main and field switches should always be habitually open when the machine is not running.

Care should be taken not to connect alternators in parallel when they are out of synchronism, as the excessive rush of current throws heavy strains on the engines and generators and may cause considerable damage.

It is well to remember that alternators are designed for the voltage indicated on the name plate. They must not be expected to give voltages considerably above normal with satisfactory performance of either exciter or alternator. This point is here mentioned because frequent attempts to raise the voltage an excessive amount have resulted in poor operation through no fault of either exciter or alternator. Furthermore, the rated current output should not be continuously exceeded.

Every now and then the air-gap between stator and rotor should be checked and the machine realigned, if necessary. This applies particularly to engine-type generators. Bolts and nuts should be kept tight, and receive as much attention in electrical machinery as in steam engines.

INDUSTRIAL

NATIONAL ALTERNATORS.

Recently the National Brake & Electric Company, of Milwaukee, installed in the plant of the Merchants' Heat, Light & Power Co., of Canton, Ohio, two 2-phase 2,300-volt alternators for direct connection to Russel cross-compound non-condensing engines. These alternators are of symmetrical lines with special operating characteristics. The frames are of cast iron with sole-plate extensions for supporting them on the engine foundation. Soft sheet-steel laminations are dove-tailed within the frame so as to form slots for receiving the windings. These laminations are carefully japanned to reduce core losses to a low value, and also insulate them from each other and are very rigidly supported between end plates at such intervals as are ample to insure good ventilation. The laminae are supported by distance plates which provide air passages. The armature windings are composed of strap-wound coils insulated with sheet material of high mechanical strength and dielectric properties. The completed coils are wrapped with linen tape and repeatedly dipped in a vat of special insulating compound. Exceptional care and attention to this part of the machine has resulted in close regulation and large over-load capacity.

The field spiders are of cast iron and are liberally dimensioned to withstand torsional and centrifugal strains. The fields of these generators are wound with copper ribbon in edge-wise fashion, thus exposing every turn of the coil to the air and giving a compact, rigid and practically indestructible coil. A special fibre paper insulates the turns of the coil from each other in a thoroughly effective manner. A special feature of these machines which contributes very largely to their low operating temperatures is the use of widely separated pole pieces, which construction requires a spider of large diameter and prevents crowding of the coils; thus the coils have a large radiating surface. The method of bolting the pole pieces to the rim of the spider gives unusual accessibility to any portion of the armature or field winding. The bearings of these machines are of generous size, which gives a large wearing and radiating surface; they are babbitt-lined and are made with a sufficient number of grooves and oil rings to give uniform lubrication throughout the entire length of the bearing. The collector rings are built up on a separate skeleton-type spider which gives them splendid ventilation. The rings are cast iron and fitted with carbon brushes so that wear and attention are reduced to a minimum. The generators are excited with a current from 110-volt exciters which are belted to the shafts of the engines.

A NEW HYDRO-ELECTRIC PLANT IN CALIFORNIA, OF EXCEPTIONAL MAGNITUDE.

The Stanislaus Electric Power Company, through The Union Construction Company, has just closed a contract for an electric power transmission scheme of extreme importance to California industries. The site of the proposed plant is at Vallecito, on the Stanislaus River, near Angels' Camp., Cal., and the scheme contemplates the utilization of the waters of the Stanislaus River. Electric power will be transmitted to San Francisco, as well as to the Southern Mines and the upper San Joaquin Valley. From a hydraulic standpoint the project is of particular interest as it involves the largest power units that have probably ever been used for impulse wheels. The operating head is 1,400 feet, equivalent to a pressure of 608 pounds per square inch. The contract calls for three 6,700 kilowatt, General Electric generators, each of which will be driven at 400 revolutions per minute by a Pelton water-wheel unit of 12,000 horsepower capacity, thus giving the plant a capacity of 36,000 horsepower. Probably the only plant in the West, approaching this in the size of impulse of water-wheel employed, is that of the Puget Sound Power Co., at Electron, Wash., where are installed four Pelton wheel units, each driving a 3,250-kilowatt generator, with a combined maximum capacity for the station of 30,000 horsepower.

The units for the Stanislaus plant will be of the "double overhung" construction, characteristic of Pelton design for high-power practice. Each unit will consist of two Pelton wheels, each overhanging the opposite end of a heavy shaft which carries the rotor of the generator midway between. The wheels proper each consist of a cast-steel annealed disc-center to which are attached the Pelton buckets, also of cast steel. The buckets will be secured to the center by means of turned steel bolts hydraulically pressed into reamed holes —a novel idea in water-wheel construction. The shaft will be of fluid-compressed, hollow-forged nickel stell, and will be 28 feet in length, 20 inches in diameter at the center where the rotor is located, and 16½ inches at the water-wheel journals. The wheels and rotor will be designed for a press fit on the shaft at 100 tons pressure. The journals, one on each side of the generator, will be larger than any heretofore designed for this class of work, being 16½ inches in diameter and 60 inches lond. They are of the ring-oiling, ball and socket type, water jacketed and provided with an oil-pressure and gravity-feed lubricating system. Also there will be furnished electric thermostats and indicators to give warning of any excessive rise in temperature. The nozzles will be of the needle-deflecting type, admitting of close regulation and water economy, and are to be of cast steel, as are also the gate valves. These latter will be of the single-disc Pelton type, with phosphor-bronze seats ground in place. They will be provided with roller bearings to relieve the thrust on the stems, and will be actuated by gearing by means of small Petlon motors.

At the switchboard will be located the main pilot control, by means of which the operation of gates, nozzles and needles may be under the immediate control of the station attendant, small pelton motors and direct- acting plungers being employed for this purpose. All pressure parts on these units are to be subject to a cold-water test of 1,200 pounds per square inch in the shops before shipment. The equipment will represent the highest development in hydro-electric transmission, and the installation is looked forward to with the greatest interest by engineers generally. The construction is under the direct supervision of the engineer-

ing firm of Sanderson & Porter, New York. The complete hydraulic equipment will be furnished by the Pelton Water Wheel co., of San San Francisco, and the electrical apparatus by the General Electric Co.

Indications are that the year 1907 will eclipse its predecessor in the development of hydro-electric power transmission. The Pelton Water Wheel Company reports unusual activity in this direction, and will carry over unfilled orders aggregating the largest in the history of its business. The marked tendency is towards high speed, large-power units. For example, the California Gas & Electric Co. is installing a Pelton wheel of 10,500 horsepower maximum capacity. The Telluride Power Co., of Colorado, is adding to its equipment one 5,000-horsepower Pelton wheel operating under a head of 900 feet, and one 4,000-horsepower Pelton wheel operating under a head of 1,800 feet. This company has installed a continuous lapweld, high-pressure pipe made by the Ferrum Co., of Germany, which the Pelton company has introduced in America with much success in the past two years. The Siskiyou Electric Power Co. has ordered two Pelton water-wheel units, each of 2,000-horsepower capacity, these being in addition to their present water-wheel equipment.

PROGRESSIVE ACTION OF A PACIFIC COAST COMPANY.

The Telephone and Electric Company, of San Francisco. was recently incorporated to take over and carry on the old and well established business of the Brown-Spear-Sloane Company. For many years this latter firm has been acting as Pacific Coast representatives for many of the best known manufacturers of electrical supplies in America; and through its San Francisco, Los Angeles, Portland and Seattle branches has become well known to electrical jobbers in the West.

The new company differs from the old practically in name only, as the personnel remains very much the same. With an increased capital the company will carry on its business on a much larger scale, and has therefore incorporated under a name which specifically points out the class of merchandise dealt in.

The officers of the new company are: Frank L. Brown, president; Lewis E. Spear, vice-president; Victor Enginger, treasurer; and Garnett Young, general manager. Messrs. Brown, Spear and Enginger are well known through their connection with the old company, the Pacific Steel and Wire Company, and the California Wire Cloth Company. Mr. Young was in charge of the Los Angeles branch of the Brown-Spear-Sloane Company for the past three and a half years.

The sales department of the San Francisco branch will be in charge of Mr. Ralph L. Phelps. Mr. H. H. Manny will manage the Seattle and Portland branches, and Mr. A. B. Vandercook the Los Angeles branch.

The department of telephone appliances is in a position to furnish everything in telephone apparatus necessary to fully equip independent telephone exchanges. The electric supply department includes a general line of materials and appliances for electric wiring and lighting as well as heavy construction equipment of the nature required by power plants and transmission lines, while the railway department furnishes overhead and track material for steam and electric roads.

As before pointed out, this company does not manufacture electrical supplies, but acts as representatives for large and well-known manufacturers. The local warehouses, maintained in connection with each branch, are kept heavily stocked with an extensive line of electric appliances, and jobbers sending in orders can expect prompt deliveries.

The general offices of the Telephone and Electric Equipment Company are in the Union Trust Company's building, San Francisco.

News Notes

ELECTRIC RAILWAYS.

San Diego, Cal.—H. E. Huntington has bought by wire 120 acres in Roseville from F. D. Murtha. The positive assertion is made that a $700,000 water system will be established in the San Luis Rey Valley, which Huntington bought a year ago, and that the line to this city will be operated by electricity generated from dams to be constructed. Twenty thousand horsepower will be generated.

Chesaw, Wash.—Commissioners granted a franchise to the Okanogan Electric Ry. to construct its line from Nighthawk to the Columbia Valley. A. M. Dewey, president.

Chewelah, Wash.—The United Copper Co. has completed survey for its electric road from the mine to the Spokane Falls & Northern Ry. yards.

Butte, Mont.—James Breen and associates of Spokane, propose to construct an electric line from here to Anaconda by way of Gregson.

North Yakima, Wash—Work will be commenced at once by Engineer E. M. Kenley locating an electric suburban railway connecting a number of valleys with this city.

Portland, Ore.—C. E. Loss of the United Railways Co. states that work will be commenced within 30 days on the Front-street line.

Seattle, Wash.—Council granted franchise to S. E. Co. for construction of street railways on Summit avenue et al; 31st avenue et al; 19th avenue, Ewing street and Wallingford avenue et al.

Spokane, Wash.—The Inland Empire Railway Co. awarded contract for fencing its line from Palouse to Moscow, a distance of 32 miles, to the Excelsior Fence Works of this city.

Reno, Nev.—The directors of the Nevada Interurban Electric Railroad Company, recently formed in this city for the purpose of building a railroad from Reno to Moana Springs, and eventually to Lake Tahoe, have ordered a large quantity of ties and the steel for the new line. Work on the road will commence next week and will be rapidly rushed to completion.

Alameda, Cal.—A condemnation suit, filed January 2nd by F. M. Greenwood, a San Francisco capitalist, who obtained a franchise to operate an electric railway in Alameda last March, marks the first act taken toward the construction of the line. Linwood Palmer and Timothy L. Barker are named as defendants. The land sought to be condemned by Greenwood is a strip 60 feet wide, running along the extension of Clement Avenue from the extension of Pearl Street to the extension of Versailles Avenue. The Cohen property is its eastern boundary. It is a little more than 404 feet long. The Greenwood line, as applied for, is to connect with a ferry boat on the western shore of Alameda, about 2,000 feet south of the Alameda mole of the Southern Pacific. Quick ferry service between Alameda and San Francisco is part of the program. From this point the line runs across the Alameda marsh, crossing Webster Street near the old powerhouse of the Oakland Traction Consolidated. It strikes Clement Avenue at its western end and runs along that thoroughfare to its end. Haywards is named in the complaint as the eastern terminal of the road. Branch roads in Alameda are also contemplated. Although the franchise was granted nearly ten months ago, no step toward actual construction of the road has yet been taken. The Board of Trustees of Alameda has granted extensions of time to the company, which pleaded that it had been impossible to begin. At the time of the granting of the franchise it was freely hinted that the line projected was part of a transcontinental line that was attempting to get into San Francisco, and Greenwood admitted that his company was an adjunct to a greater plan.

TELEPHONES AND TELEGRAPH.

Bellingham, Wash.—The directors of the Farmers' Tel. Co. decided to at once extend the lines of the system. Work on the South Pass line to Kendall and Maple Falls is now under way.

Centralia, Wash.—Lumbermen are planning to build a private line to connect the different saw mills.

Diamond, Wash.—The Diamond Tel. Co. has been incorporated by F. W. Estel, W. M. Lee and Henry Rock, capital $2,000.

Spokane, Wash.—The Interstate Tel. Co. announced that its toll line is now completed into the city.

Oakland, Cal.—The Sunset Telephone & Telegraph Company is preparing to spend an immense amount of money in improvements in Oakland. The business has grown to such an extent in the past few months that it is almost impossible to handle it from the present main office—at least, it will be impossible to do so when the improvements at present under way are completed. To handle the growing business a class-A reinforced concrete building is to be erected at once at the corner of Telegraph Avenue and 45th Street. This building will cost $40,000, and will be two stories in height. It will be one of the finest office buildings owend by the company in the State. C. W. Dickey is the architect.

Pacific Grove, Cal.—The Monterey City Board of Trustees has granted the Monterey, Fresno and Eastern Railroad the right of way for telegraph and telephone lines and a double-track electric roalroad over certain streets, for fifty years.

Oakland, Cal.—The division manager, Peter J. Lynch, of the Pacific Telephone and Telegraph Company, states that his company will establish a branch office in the Fruitvale and Elmhurst district. The building will be erected on their lot on San Leandro Road, near Aakland Avenue, of reinforced concrete and brick, and will be equipped with a multiple switchboard, which will control the telephones.

Elsinore, Cal.—An ordinance has been passed, granting to the Southwestern Home Telephone Company the right to construct a telephone, telegraph, electric light, heat and power line in Elsinore.

OIL.

Hanford, Cal.—E. Fitzpatrick, who has been over in San Benito County drilling a well for the New England-California Oil Company, is spending a few days in Hanford. Mr. Fitzpatrick says that several wells were put down over there, but the drilling was stopped before the wells had gone deep enough to show whether there was oil there or not. The company is to do deeper prospecting.

Vallejo, Cal.—James Clyne, a well-known Benicia resident, has transferred to a Los Angeles oil company, 26 acres of land midway between Vallejo and Benicia on the Carquinez Straits. The new corporation plans to build an oil refinery for crude oil which will be brought from the southern fields. A spur track three miles long is to be built by the Southern Pacific Company from Benicia, to furnish shipping facilities for the plant. The company will build a large number of steel tanks on the hills back of the works. The new concern has already ordered 500 tons of structural steel for the commencement of building operations, and no time will be lost in getting the new project under way.

Eureka, Cal.—The North Mountain Power Co. has just received 10,000 barrels of oil from the Associated Oil Co. Owing to the scarcity of coal many of the manufacturers in this section are changing to oil.

POWER AND LIGHT PLANTS.

Kalispel, Mont.—The interest of the Tinkels and Conrads in the Big Fork Water Power plant have been taken over by the Flathead Valley Power Co., which recently filed articles of incorporation. The new company is capitalized for $50,000. Fifty thousand dollars will be expended in improvements at the Big Fork plant; 2,000 horsepower will be developed. C. T. Moffett, manager.

Leavenworth, Wash.—The G. N. has a surveying party at work locating a large power plant at Big Lake. It is expected to develop more than 100,000 horsepower.

Seattle, Wash.—Superintendent Youngs has received notice that a 4,000-pound carload of electric light wire was on its way here from Perth Amboy, N. J.

Seattle, Wash.—Council has decided that both First and Second avenues are to be lighted with cluster lights.

Spokane, Wash.—It is reported that $2,000,000 will be expended by the promoters of the Ox Bow power project before their plant is complete.

The Kern River Power Plant No. 1 of the Edison Electric Co., is to have the gate valves on the 28-inch water gates controlling the hydro-electric equipment there, operated by Allis-Chalmers vertical shaft motors and gearing.

Redding, Cal.—The Northern California Power Company, which already has three power plants in this county, has commenced work on a fourth, which will have a greater capacity than the other three combined. The new plant will be erected on Battle Creek, below Volta, and will be of a capacity to develop 12,000 horsepower, or 2,500 horsepower more than the other three combined. Men have been set at work on the construction.

Carson, Nev.—James T. Shaw, a prominent mine owner of the district of Masonic, Cal., is in the city arranging for the building of a large electric plant in the new mining camp of Mono County. The machinery has been ordered from San Francisco, and the company, of which Mr. Shaw is president, intends to begin the construction of the plant in a few weeks. The plant will be used for lighting and to work a number of electric hoists being erected in the district.

Chico, Cal.—W. J. Bowen, who has been serving the Northern Electric Company in the capacity of purchasing agent, has been advanced to a place in the right-of-way and land department of that company. He will be associated with G. E. Springer in the work attached to securing rights of way. The successor to Mr. Bowen is M. C. Jones, of San Francisco.

Kennet, Cal.—Considerable interest is being taken in the operations of the Northern California Power Company in the construction of its 50-ton experimental electric smelting plant for iron ores, to be located six miles east of Kennet, near the confluence of the McCloud and Pit rivers. Operations are under the supervision of W. S. Morgan, of San Francisco, and a force of about 25 men is at present employed.

Redding, Cal.—The Shasta Power Company has completed setting poles throughout Redding, covering the section bounded by North, East, West and South streets. The pole lines run through the alleys, instead of on the streets. The poles of the main line, from Redding to the power plant,

It is reported that the Eureka Lighting Co. is about to close down its Station "A."

Eureka, Cal.—The North Mountain Power Co., which secured the contract for the city lighting for the coming year, were somewhat delayed in putting in service their "Magnatite" lmps, due to certain machinery not arriving on time. These lamps are now in good working condition.

POWER PLANTS.

Porterville, Cal.—A. Genslein, general manager of the Porterville Gas and Electric Company, has been in Los Angeles and there met with the board of directors for the purpose of getting a report of their engineer, J. R. Thompson, who was here last week. The engineer was ordered to make drawings, plans and specifications for a complete gas plant for the city of Porterville at once.

Pasadena, Cal.—Bids have been opened for the issue of $200,000 municipal bonds, $125,000 of which are for electric lights and $75,000 for fire department extension, and the award was made to E. E. Webster, formerly connected with one of the local banks, who bid par value together with accrued interest to date of delivery. It is thought Mr. Webster represents a syndicate of Los Angeles capitalists.

Fort Bayard, N. M.—Sealed proposals in triplicate, for furnishing and installing electric light fixtures in the Post Exchange at this post, will be received here until January 23rd, and then opened. The United States reserves the right to accept or reject any or all proposals or any part thereof. Envelopes containing proposals should be endorsed: "Proposals for Electric Light Fixtures in Post Exchange," and addressed to Captain S. P. Vestal, Quartermaster.

Los Angeles, Cal.—An application has been made to the Board of Supervisors, by the Pacific Light and Power Company for a franchise to set poles, string wires and furnish electric light and power over same, on every road in the county, except where it has not now such wires, and also excepting in incorporated towns. The District Attorney was directed to draw up a notice of the sale.

Bisbee, Ariz.—E. F. Gressler, manager of the International Gas and Light Company, is en route to Los Angeles to make arrangements for the delivery of material for installation of the electric lighting plant, for which his company was granted a franchise.

Los Angeles, Cal.—An ordinance has been adopted ordering that necessary appliances be installed and electric curren be furnished for one year for lighting Carr Street between the center line of Main and the center line of Hill Streets, sealed proposals for which will be invited.

FINANCIAL.

San Francisco, Cal.—The interests represented by the Fleishhackers, the London, Paris and American Bank and the San Francisco Coke and Gas Company, are reported to be preparing to combine the power and paper interests of the Fleishhackers at Floriston, on the Truckee River, and the local plant of the San Francisco Coke and Gas Company. The companies will be financed by the London, Paris and American Bank, in which the Fleishhackers and Leopold Michels, president of the gas company, will soon become heavy stockholders. Sigmund Greenebaum will continue as president of the bank.

New York, N. Y.—In an interview on January 8th, Ernest Thalman says he expects a gradual appreciation in United Railroads securities. This is his comment after giving out a statement of the earnings for December and for the year. He talks optimistically on both San Francisco and the company. He says that, "Notwithstanding the delays and losses occasioned by the fire and strike in San Francisco, the gross receipts of the United Railroads for 1906 have decreased only $1,116,000 from the earnings of 1905, which were $5,941,000. The gross passenger receipts for December were $556,000. The officers and directors of the United Railroads are confident that the rebuilding of San Francisco will go forward with continued vigor. They report the labor situation steadily improving, and that the company now has no difficulty in obtaining all the labor necessary for the reconstruction of its old cable lines, and the entire work of reconstruction will be finished by Spring. It is confidently believed that the earnings for 1907 will exceed those of 1905."

TRANSPORTATION.

Vallejo, Cal.—Contractor Frank Gore of this city has commenced grading for the Vallejo, Benicia and Vaca Valley electric road, about two miles from this city, on the Benicia road. Over 1000,000 ties have arrived for the Vallejo and Napa Interurban electric road, and these will be used in the extension of the road from Napa to Calistoga.

San Francisco, Cal.—The first shipment of the United Railroads' new special San Francisco cars have come out of the factory at St. Louis and have been started westward. Agents are to placed along the railroad to see that the consignment is nowhere unnecessarily delayed. The cars are expected January 21.

Fresno, Cal.—One of the surveyors of the New Yosemite electric road is now in Fresno. He brings word that the survey is progressing rapidly, notwithstanding the fact that the weather is disagreeable and the snow is a foot or so thick on some parts of the mountains. The line has now been located to within five miles of Crane Valley. Once this valley is reached the important part of the work will have been accomplished, for there Chief Engineer Newman will be in a position to make his estimate which will determine whether the road will or will not be built. The 18 miles that have been surveyed thus far have come quite within the estimate, so that it would seem certain that the cost of construction on the remaining five miles could not possibly be so expensive as to offset the advantage gained on the 18 already covered.

Woodland, Cal.—Several property owners of this city have been approached by representatives of the Vallejo and Northern Electric Railway Company with reference to options on their property. The property owners refuse to talk about the matter, but it has been ascertained that the negotiations are in progress.

Salinas, Cal.—The electric road that has been promised between Monterey and Salinas seems in a fair way to be realized. Last week surveyors started out from Monterey to find the shortest and most feasible route from that city to Salinas, and it now looks as though construction work will begin in January. It is believed that this piece of roadway will be part of the line between Monterey and Fresno.

San Diego, Cal.—Papers are now being prepared for filing with the City Council, by W. G. Kirkhoff and P. W. Keller, asking for the granting of franchises to the extent of 33 miles, for the benefit of H. E. Huntington. These franchises include those held for some time by H. T. Richards, the well-known surveyor, who has been supposed to be in the service of the Southern Pacific. They include a line along the water front, across the mouth of False Bay and north via La Jolla and Delmar toward Oceanside and Los Angeles; and another up Mission Valley toward Escondido. The other portion of the franchise is for branches to Ocean Beach and Point Loma. A bond of $20,000 is offered to insure commencement of work inside of 90 days.

Reno, Nev.—It is stated in this city that the Southern Pacific Company is planning to reconstruct its line from Reno to Carlin, a distance of about 250 miles, and run electric trains between the two places, instead o fsteam trains. It is the intention of the company to install electric engines and to increase the speed schedule from Sparks to Carlin. Engineer Barclay, who has charge of Southern Pacific construction work in Nevada, was in town a few days ago for the purpose of estimating the cost of the electric project. It is reported in railroad circles that the electric engines and trains would be able to travel at a speed of nearly 150 miles per hour across the Nevada Desert. The railroad company will obtain its power from the Truckee River General Electric Company, which operates four power plants along the banks of the Truckee River between Reno and Floriston.

POWER AND LIGHT PLANTS.

Boise, Ida.—H. B. Perrine of Seattle states that his firm is figuring on installing machinery for the completion of the power plant at Shoshone Falls. A transforming house is to be built at Twin Falls.

Columbia, Wash.—Preparations are said to be under way for the construction of a gas plant here by H. J. Miller of this city, to cost $30,000.

Livingston, Mont.—The Livingston electric light plant, owned and managed by J. L. Bright, was sold to Henry F. Kroyer of New York. M. Hebgen, superintendent of the Butte Electrical Works, will supervise the work of extending the power from the Madison River Power Company's lines to connect with the plant here.

North Yakima, Wash.—The reclamation service sent a force of men to the Tieton River to arrange for the construction of a large electrical power plant, to be used in connection with the building of the Tieton Canal.

Spokane, Wash.—Henry M. Richards of the W. W. P. Co. states that plans are being made for increasing the electric plant of the company to at least 70,000 horsepower. The capital stock of the company is to be increased to $10,000,000.

Boise, Ida.—Guy C. Barnum of Shoshone has sold his interest in Thousand Springs Land & Transportation Co. to A. M. Harris. The company is building a power plant in Lincoln County that will develop 12,000 horsepower.

Cheyenne, Wyo.—The Northern Colorado Power Co., which purchased the plant of the Cheyenne Light, Fuel & Power Co., is contemplating the erection of a new electric plant, estimated cost, $1,000,000.

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